

**IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF NEW YORK**

CAROTEK, INC.,)	
)	
Plaintiff,)	
)	
v.)	Civil Action. No. 07 11163
)	
KOBAYASHI VENTURES, LLC,)	
)	
Defendant.)	
_____)	
EVENT CAPTURING SYSTEMS, INC.)	
)	
Plaintiff,)	
)	
v.)	
)	
KOBAYASHI VENTURES, LLC,)	
)	
Defendant.)	
_____)	

**STATEMENT OF MATERIAL FACTS
PURSUANT TO LOCAL CIVIL RULES 56.1
IN SUPPORT OF PLAINTIFFS' MOTION FOR SUMMARY
JUDGMENT ON INVALIDITY AND NON-INFRINGEMENT ISSUES**

1. Carotek is a licensee under a license agreement ("License Agreement") entered into with Champion Paper in 1998 that granted Carotek a non-exclusive license to make, use, and sell certain products allegedly covered under a group of certain patents referred to in this Memorandum as the "Champion Patents." [Ex. 1].

2. Kobayashi has accused Carotek of infringing the Champion Patents, [Counterclaim, dated February 8, 2008, at p. 17], and has sent letters to numerous of its customers alleging infringement claims against those customers. [“Customer Letters”, Ex. 2, and 3].

3. Carotek sold the part of its business relating to the Carotek License Agreement to Event Capturing Systems (ECS), Inc. on December 31, 2007.¹ [Bell Depo. p. 12, l. 14-17, Ex. 4].

4. ECS has also been threatened with suit for infringement by Kobayashi, and has filed its own Declaratory Judgment action with this court, which is now consolidated with the prior-filed Carotek action. [ECS Decl. Judg., dated June 24, 2008, and Court Order, dated July 17, 2008].

5. The ECS Monitoring System previously made and sold by Carotek and now made and sold by ECS is a monitoring system used for monitoring the production of paper in a manufacturing facility. [Tam Decl. at ¶ 2, Ex. 5].

6. The ECS Monitoring System allows an operator to review the production process if a paper break occurs. Id.

7. The ECS Monitoring System provides multiple cameras positioned about a manufacturing line and the cameras are configured to record the manufacturing of a product. Id. at ¶ 3.

8. At the instance when a paper break occurs, at least one trigger is positioned about the manufacturing line and is configured to output a signal when a deviation is detected. Id. The

¹Kobayashi has variously taken the position that ECS is a separate company and has sought to dismiss patent infringement claims against Carotek on these grounds. Now Kobayashi has taken the position that “ECS is a fraudulently (sic) created entity, created with a sham transaction, and in connection with an effort by Carotek to avoid liability for, among other things, patent infringement.” [Kobayashi Answer and Counterclaim in ECS case, dated September 2, ¶ 58, 2008]. According to Kobayashi, ECS and Carotek are one in the same, and therefore, ECS is entitled to join in this action.

signal that is output by the trigger is a simple 0/1 logic signal, and outputs 0 under normal operating conditions and 1 when the trigger is initiated. Id.

9. An ECS Monitoring System computer records video continuously and saves the video in file segments on a computer's hard disk. Id. at ¶ 4. Each file segment is of a fixed time length (called the pre-event time) that corresponds to the total time for the paper to travel from the beginning to the end of a paper machine. Id.

10. Upon receiving a trigger signal, the video segment in recording will continue to record for a predetermined additional amount of time (called the post-event time). Id. at ¶ 5. The ECS Monitoring System then time-stamps the trigger signal and simply renames the current segment and the previous segment from the existing video buffer using the timestamp as the main body of the file name structure. Id. The deviation file is saved within the exact same directory as a non-deviation event file would be saved. Id. at ¶ 6.

11. For an ECS Monitoring System with multiple cameras, multiple computers are connected to an ECS Monitoring System master computer. Id. at ¶ 7. As the master computer receives the trigger signal, video files corresponding to the event trigger time are saved from each camera, and collectively these video files form an ECS Monitoring System paper-break event. Id. This event is available for the operator to review at any time. Id. at ¶ 9.

12. There is no need to look for and then extract the relevant image frames from the video buffer in each of the recording computers because any relevant image frames from that video camera related to this paper break event must be included in the two renamed video files from each computer. Id. at ¶ 8.

13. As an event is loaded on a video window, video files from each camera are loaded onto different video windows. Id. The camera associated with the trigger source is called the anchor

camera and is loaded first and then the video frame at event trigger time is displayed. Id. at ¶ 9.

The remaining cameras are opened up by a linear sequencing program in different video windows at a time frame offset from the anchor camera so that the image frame shown in each window is time-offset based on the relative locations of this camera as compared with the anchor camera along the paper machine. Id.

14. Alternatively, the operator may open each additional image frame on the same video windows. Id. Each video monitor window plays a file corresponding to the camera associated with that video window, and the operator of the ECS Monitoring System will have to view multiple files to view the monitoring sequence. Id. Unlike the Champion Patents which require that each monitoring sequence be extracted from each hard drive and then spliced together to form one continuous video, there is no splicing of data clips together to form one video file. Id. at ¶ 11.

15. The Champion Patents utilize a form of claim called a “means-plus-function” claim as permitted in 35 U.S.C. § 112, ¶ 6. Means-plus-function language is a functional method of patent claiming which requires specific structure within the specification to carry out the functional language. [Ex. 6].

16. The Champion Patents all claim a “control means” for performing a computer function. [Ex. 6]

17. The “control means” is required to “locate the data clip containing data of such event, to extract such data clip and to display said data clip.” [‘456 patent, col. 6, lines 53-57, Ex. 6].

18. Nothing in The Champion Patents describes an algorithm by which the control means “controls the monitoring system.” [Ex. 6].

19. All of the Champion Patents share the same disclosure since they are all divisional applications. [Ex. 6].

20. The ECS Monitoring System does not infringe any means-plus-function claim of the Champion Patents because each and every independent claim recites either a control means or a computer for or configured to *identify and extract a deviation video signal* from one of the segments of video. [Ex. 6].

Respectfully submitted,

/s/ Raymond R. Castello
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CERTIFICATE OF SERVICE

The undersigned hereby certifies that the foregoing **STATEMENT OF MATERIAL FACTS** was served on the Defendant by sending copies by E-Mail:

Alexia Bourgerie
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on September 3, 2008.

/s/ Miranda Perkins

EXHIBIT 1

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LICENSE AGREEMENT

THIS AGREEMENT, made and entered into this 8th day December, 1998 between CHAMPION INTERNATIONAL CORPORATION, a New York Corporation having an office at One Champion Plaza, Stamford, Connecticut 06921 (hereinafter referred to as "CHAMPION", or the "Party") and CAROTEK, INC. a corporation organized and existing under the laws of North Carolina, having an office at 700 Sam Newell Road, P.O Box 1385, Matthews, North Carolina 28106 (hereinafter referred to as "LICENSEE" or the "Party").

WITNESSETH THAT:

WHEREAS, CHAMPION is the owner by assignment of certain patents and patent applications (hereinafter referred to and defined as "Patent Rights") involving a proprietary process monitoring system (hereinafter referred to and defined as "CV² System");

WHEREAS, LICENSEE desires the non-exclusive right under said Patent Rights to make, use and sell CV² System and the right to further develop such System;

WHEREAS, CHAMPION is willing to grant such non-exclusive right and license to the extent that CHAMPION has the right to do so.

NOW, THEREFORE, in consideration of the promises and mutual covenants herein contained, and other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the parties hereto agree as follows:

ARTICLE I - DEFINITIONS

As used herein, the following terms shall have the following meanings:

1.1 "Effective Date of this Agreement" shall mean the date first hereinabove written.

1.2 "Patent Rights" shall mean the United States and foreign patent(s) and patent application(s) listed in attached Schedule A, as well as any patent(s) issuing on the said applications and any divisionals, continuations and reissues and extensions thereof.

1.3 "CV² System" shall mean the process monitoring system claimed in Patent Rights and shall include but not be limited to all equipment sold, leased or otherwise transferred by LICENSEE under this Agreement, whether manufactured or created by LICENSEE or by a third party, such as video cameras, computers for capturing and viewing, data storage devices (i.e., disks, tapes, CD-ROMS), networking equipment (i.e. hubs, routers, bridges), switching units, power supplies, interconnecting panels and cables, and wiring for connecting various components together.

1.4 "Cost of Services" shall mean the cost of consulting, engineering, installing, supervising and like services performed by or for LICENSEE for the sale and installation of CV² System and shall be equal to TEN PERCENT (10%) of the total gross selling price for CV² System.

1.5 "Fully Absorbed Manufacturing and Installation Cost" shall mean the most favorable price offered by LICENSEE or Subsidiary of LICENSEE and accepted by a third party other than the price for the first (1st) sale of CV² System in each country, within six (6) months prior to the date

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of sale to LICENSOR or Subsidiary of LICENSOR for the sale, installation, license, lease or other transfers of CV² System less twenty-five percent (25%) of such most favorable price, which Cost shall be subject to audit by CHAMPION on an open book basis during normal business hours upon reasonable prior notice.

1.6 "Subsidiary" shall mean:

1.6.1 Any corporation or other juridical business entity owning, or directly or indirectly controlling at least twenty percent (20%) of the stock of a Party entitled to vote for election of directors; and

1.6.2 Any corporation or other juridical business entity at least twenty percent (20%) of whose stock, entitled to vote for election of directors, is owned, or directly or indirectly controlled by a Party.

1.7 "CV² System Installation" shall mean the design, sale, installation, license, lease and/or other transfer of a single CV² System for monitoring the operation of a single unitary, integrated and stand alone process or apparatus used in the conduct of such process, whether in the paper, printing or other industry, (i.e. paper making machine, off machine coater, super calender, winder, etc.) or upgrades to a single existing installed CV² System.

1.8 "Reporting Period" shall mean each semiannual period during the term of this Agreement, the first of which shall commence on the Effective Date of this Agreement and shall end on December 31, 1998, the second of which shall be from January 1, 1999 until June 30, 1999, the third of which shall be from July 1, 1999 until December 31, 1999, and the subsequent periods from January 1 until June 30 and July 1 until December 31 of the following years of the term of this agreement.

1.9 "Commercial Sale" shall mean the CV² System Installation by LICENSEE and/or Subsidiaries of LICENSEE to a bona fide purchaser in good faith who is the user of the CV² System and does not include internal sales or transfers by and between LICENSEE and Subsidiaries of LICENSEE.

1.10 "Net Sales Price" shall mean the sum of the Cost of Services and the gross price of Commercial Sales of CV² System less packaging charges, transportation charges; insurance against loss or damage in transit; sales, excise use and similar taxes directly incurred by LICENSEE in connection with the relevant Commercial Sale; importation duties and levies and selling commissions by resellers and agents who are not Subsidiaries of LICENSEE. If CV² System are sold, licensed, installed, designed, leased or otherwise transferred as components of a combined system, the Net Sales Price for CV² System shall be calculated by multiplying the Net Sales Price of said combined system as determined above by a fraction, the denominator of which is equal to the total list price of said combined system and the numerator of which is equal to the list price of said CV² System.

ARTICLE II-LICENSE GRANT

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2.1 Effective as of the Effective Date of this Agreement, CHAMPION grants to LICENSEE and LICENSEE accepts the worldwide, non-transferable, non-exclusive right and license under Patent Rights to make, use, and sell CV² System.

2.2 LICENSEE shall have the right to grant sublicenses to customers of the CV² System from LICENSEE and Subsidiaries of LICENSEE provided that a royalty has been paid to CHAMPION in accordance with ARTICLES III and IV below.

2.3 Except as expressly set forth in this ARTICLE II, no other licenses or rights are granted to LICENSEE or any other party under this Agreement with respect to any patent, patent application, trade secret, copyright, proprietary information or any other property right belonging to CHAMPION.

ARTICLE III - ROYALTIES

3.1 During the term of this Agreement for each CV² System Installation by LICENSEE and Subsidiaries of LICENSEE to person, business, corporation, partnership or the like which is not a bona fide purchaser in good faith who is the user of the System of said CV² System Installation (i.e. distributors, resellers, and the like other than Subsidiaries of Licensee), LICENSEE shall pay to CHAMPION a running royalty of EIGHT PERCENT (8%) of the Net Sales Price of CV² System for each of said CV² Installations.

3.2 During the term of this Agreement for each CV² System Installation by LICENSEE and Subsidiaries of LICENSEE to person, business, corporation, partnership or the like which is a bona fide purchaser in good faith who is the user of the System of said CV² System Installation (i.e. printers, paper makers, article manufacturers and the like), LICENSEE shall pay to CHAMPION a running royalty of FIVE PERCENT (5%) of the Net Sales Price of CV² System for each of said CV² Installations.

3.3 Internal sales and transfers by and between LICENSEE and Subsidiaries of LICENSEE as set forth in Paragraph 1.9. are excluded from Paragraphs 3.1. and 3.2. and do not require a royalty payment hereunder where the purchaser or transferee of the CV² System is not the manufacturer of product for commercial sale.

3.4 During the term of this Agreement and beginning January 1, 1999, LICENSEE shall pay to LICENSOR minimum guaranteed annual fees of TWENTY-FIVE THOUSAND DOLLARS (\$25,000.00) per calendar year. Minimum guaranteed annual fees shall be paid to LICENSOR within thirty (30) days after the end of the calendar year for which such fees are due and payable. With respect to any calendar year, LICENSEE shall be entitled to a credit for any royalties under paragraphs 3.1 and 3.2 actually paid to LICENSOR under this Article III during such calendar year against minimum guaranteed annual fees for such year.

ARTICLE IV-STATEMENTS AND PAYMENTS

4.1 LICENSEE shall render to CHAMPION all royalties fees due and payable to CHAMPION on account of sales of CV² System during the preceding Reporting Period. All payments of royalties and fees shall be paid to CHAMPION, without discount or offset, in United States of America Dollars.

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4.2 All royalties due and payable on account of sales where the currency of sale is other than United States of America Dollars shall be converted into United States Dollars at the rate of exchange quoted in the Wall Street Journal on the business day of the sale. All payments of royalties and fees shall be net, and any taxes, duties, fees, and imposts of any and every kind which may be levied by any taxing authority by reason of the execution and performance of this Agreement or of payment of any royalty or fee hereunder including but not limited to income taxes, turnover taxes, Value Added Taxes and any other taxes of a similar kind shall be borne and paid by LICENSEE, except taxes imposed directly on CHAMPION or its Subsidiaries by any taxing authority.

4.3 Accompanying each royalty payment shall be a written report showing the computation of such royalty payment with supporting information in sufficient detail for CHAMPION to understand the basis for such computation. LICENSEE shall render such written statement even if no royalty payment is due and payable to CHAMPION for a Reporting Period. Payments of royalty and rendering of written statements shall be made at the address provided in Article XXI hereof or at such other location as may be specified from time to time by notice in writing given to LICENSEE by CHAMPION.

4.4 Acceptance by CHAMPION of any payment tendered hereunder, whether or not the amount thereof shall be in dispute, shall not constitute acceptance of the account or written statement on which such payment is based.

ARTICLE V - RECORDS

5.1 LICENSEE shall keep full, true and accurate books of accounts and other records containing all particulars which may be necessary to properly ascertain and verify the license fee payments due and payable to CHAMPION by LICENSEE hereunder. LICENSEE shall upon CHAMPION's written request to LICENSEE, permit CHAMPION to examine or have examined, at reasonable times during regular business hours, such of LICENSEE's business records and those of LICENSEE's Subsidiaries as may be necessary to determine the accuracy of any written statement or license fee payment.

ARTICLE VI - COMMERCIALIZATION EFFORTS

6.1 It is understood by the parties hereto that the license fees due and payable to CHAMPION hereunder is dependent upon the efforts exerted by LICENSEE to commercialize CV² System. LICENSEE shall promote and commercially exploit CV² System and satisfy the demand for said CV² System as it does with its other major business activities and in accordance with its regular practices of promoting and exploiting its major process monitoring systems. In the performance of LICENSEE's duties and obligations under this ARTICLE VI, LICENSEE shall have the right to use its own business and promotion names in accordance with its normal practices.

ARTICLE VII - CONFIDENTIALITY

7.1 As used herein, "Confidential Information" shall include any and all information disclosed to LICENSEE by or through CHAMPION, including any information obtained by LICENSEE visually through an inspection of any sample, device, document or like tangible thing submitted to LICENSEE by or through CHAMPION or by observation at facilities of CHAMPION or CHAMPION Subsidiaries excluding, however, such information which:

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7.1.1 Is at the time of disclosure, or thereafter becomes, a part of the public domain through no act or omission by LICENSEE, or its employees; or

7.1.2 Had been independently developed by the LICENSEE or was otherwise in LICENSEE's lawful possession prior to disclosure, as shown by written records; or

7.1.3 Is hereafter lawfully disclosed to the LICENSEE by a third party which did not acquire the information under an obligation of confidentiality from or through CHAMPION.

7.1.4 Is disclosed by LICENSEE pursuant to judicial action or governmental regulation or requirement; provided that LICENSEE shall notify CHAMPION of any order or request to disclose information in sufficient time to allow CHAMPION a reasonable time to oppose the disclosure.

For the purposes of this Paragraph 7.1, specific disclosures made to LICENSEE shall not be considered to be within the exceptions above merely because they are embraced by general disclosures in the public domain. In addition, any combination of features disclosed to LICENSEE shall not be considered to be within the exceptions above merely because individual features are separately in the public domain.

7.2 During the term of this Agreement and for a period of ten (10) years from the termination date of this Agreement or any extensions thereto, LICENSEE shall hold Confidential Information in confidence employing the same precautions, but not less than reasonable precautions, that LICENSEE employs to maintain the confidentiality of its own information of like character and shall not disclose the same to any third party, without the prior written consent of the CHAMPION by an authorized officer. Notwithstanding the foregoing, LICENSEE may disclose Confidential Information to the minimum number of its directors, officers and/or employees who require access thereto for the purposes hereof and to Subsidiaries of LICENSEE assisting LICENSEE in the exercise of its rights and the performance of its obligations hereunder, provided, however, that prior to such disclosure each such director, officer, employee, Subsidiary shall be informed of his/its obligations under this Agreement relative to the confidentiality and to the restricted use of Confidential Information, and further provided that prior to such disclosure each such Subsidiary shall execute or shall have executed written agreements obligating such Subsidiary to comply with each and every obligation of LICENSEE under this ARTICLE VII and each such director, employee and/or officer shall execute or shall have executed LICENSEE's standard employment agreement which LICENSEE warrants and represents obligates each such director, employee and/or officer to comply with the terms and conditions of confidentiality and restricted use set forth in this ARTICLE VII.

7.3 LICENSEE shall use Confidential Information only for the purposes of this Agreement, and shall make no other use of such Confidential Information without the prior written consent of CHAMPION by an authorized officer.

7.4 LICENSEE agrees that all documentary, electronic or like tangible Confidential Information, including drawings, designs, specifications, computer programs, flowsheets, sketches, descriptions, data and the like obtained from or through CHAMPION and documentary, electronic or like tangible Confidential Information which is generated by or for LICENSEE which embodies or is based upon Confidential Information are and shall remain the exclusive property of CHAMPION, and LICENSEE shall maintain the said documentary, electronic or like tangible Confidential Information at all times in its custody and subject to its control. Promptly on termination or

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expiration of this Agreement, Recipient shall return all such documentary, electronic or like tangible Confidential Information, as well as all copies thereof, to CHAMPION.

ARTICLE VIII - THE INSTALLATION OF CV² SYSTEM AT FACILITIES OF CHAMPION AND CHAMPION SUBSIDIARIES

8.1 LICENSEE hereby grants to CHAMPION an option to purchase and install, in CHAMPION facilities and the facilities of CHAMPION Subsidiaries, up to ten (10) units of the CV² System at a cost not to exceed the Fully Absorbed Manufacturing and Installation Cost of such units and subject to the terms and conditions generally required by Champion in its equipment purchase agreements and agreed to by LICENSEE. The option granted to CHAMPION hereunder shall remain in force and effect in perpetuity or until the purchase and installation of the aforesaid ten (10) units of CV² System. CHAMPION may at anytime exercise its option for purchase of up to ten (10) units of the CV² System by providing written notice to LICENSEE to such effect. In such event, LICENSEE shall sell to CHAMPION or a CHAMPION Subsidiary and install at the relevant facility the very next available CV² System manufactured or have manufactured by LICENSEE or by Subsidiary of LICENSEE.

8.2 CHAMPION may purchase units of CV² System in addition to the said ten (10) units of the CV² System. The terms and conditions of such purchase sale or installation shall be no less favorable to CHAMPION than the most favorable terms and conditions offered to a third party for the purchase sale or installation a CV² System as of the date of purchase/sale or license to CHAMPION less the license fee which would have been due and payable to CHAMPION if such purchase/sale had been made to a third party.

8.3 All CV² System sold to CHAMPION or to Subsidiaries of CHAMPION hereunder shall meet mutually agreeable performance specification and guarantees, and shall be warranted by LICENSEE. The said performance specification, guarantees and warranties shall be at least as favorable to CHAMPION or to Subsidiaries of CHAMPION as the most favorable specifications, guarantees and warranties granted by LICENSEE to its other customers for CV² System as of the date of sale or license of CV² System to CHAMPION or to Subsidiaries of CHAMPION.

8.4 All persons selected and sent to facilities of a party to this Agreement in connection with any purchase, sale or installation of a CV² System under this Article VIII shall remain the employees of their respective employers as the case may be. All such persons shall observe such safety and other regulations as have been established at such facilities. Each employer shall indemnify, defend and hold harmless a party to this Agreement and its directors, officers, agents and employees against any and all loss, cost, expense or liability arising out of or resulting from any visit to facilities of such other party, by reason of injury or loss suffered by, or claim brought by, or on behalf of, any employee of such employer sent to facilities of a party pursuant to the provisions of this Agreement.

ARTICLE IX - PUBLICITY AND PROMOTION

9.1 LICENSEE shall have no right to use any business name or trademark of CHAMPION or the name of any CHAMPION employee in any manner whatsoever, including use for any publicity or promotion of the CV² System, publications pertaining to the CV² System and the like without the prior written consent of CHAMPION by an authorized officer.

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ARTICLE X - MAINTENANCE AND FILING OF PATENTS

10.1 CHAMPION shall not be obligated to pay any charges or perform any acts whatsoever, whether required by law or otherwise, for the purpose of maintaining active or enforceable any Patent Rights, and failure of CHAMPION to do so shall not relieve LICENSEE of any obligation hereunder.

ARTICLE XI - REPRESENTATIONS AND WARRANTIES

11.1 CHAMPION WARRANTS AND REPRESENTS THAT IT IS THE OWNER OF PATENT RIGHTS BY ASSIGNMENT AND HAS THE LAWFUL RIGHT AND AUTHORITY TO GRANT THIS LICENSE. EXCEPT AS EXPRESSLY SET FORTH IN THE PRECEDING SENTENCE, THERE ARE NO WARRANTIES OR REPRESENTATIONS WHATSOEVER, EITHER EXPRESSED OR IMPLIED, WITH RESPECT TO CV² SYSTEM OR PATENT RIGHTS, INCLUDING BUT NOT LIMITED TO:

11.1.1 A WARRANTY OF MERCHANTABILITY;

11.1.2 A WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE;

11.1.3 A WARRANTY THAT ANY PARTICULAR RESULT WILL BE OBTAINED THROUGH EXERCISE OF THE RIGHTS GRANTED HEREUNDER;

11.1.4 A WARRANTY OR REPRESENTATION AS TO THE VALIDITY OR SCOPE OF ANY PATENT RIGHTS; AND

11.1.5 A WARRANTY OR REPRESENTATION THAT CV² SYSTEM OR PATENT RIGHTS, OR ANY USE, LICENSE OR SUBLICENSE THEREOF OR ANY OTHER EXERCISE OF THE RIGHTS GRANTED HEREUNDER WILL BE FREE OF INFRINGEMENT OF ANY PATENTS OR OTHER PROPRIETARY RIGHTS OF A THIRD PARTY.

11.2 IN NO EVENT SHALL CHAMPION BE RESPONSIBLE OR LIABLE FOR ANY DAMAGES, LOSSES, CLAIMS, DEMANDS OR EXPENSES WHATSOEVER RESULTING FROM OR ARISING OUT OF THE SALE, LEASE, LICENSE OR OTHER TRANSFER OF, OR MANUFACTURE OR INSTALLATION OF, OR USE OF THE CV² SYSTEM BY CUSTOMERS OF LICENSEE OR SUBSIDIARIES OF LICENSEE INCLUDING ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, CLAIMS, DEMANDS OR EXPENSES.

11.3. NOTWITHSTANDING ANYTHING TO THE CONTRARY CONTAINED IN THIS AGREEMENT, IN NO EVENT SHALL LICENSEE BE RESPONSIBLE OR LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, CLAIMS, DEMANDS OR EXPENSES WHATSOEVER RESULTING FROM OR ARISING OUT OF THIS AGREEMENT.

ARTICLE XII- MOST FAVORED LICENSE

12.1 If Champion hereafter grants a license to a third party (other than a Subsidiary of LICENSEE) to practice all of the subject matter licensed under this Agreement and subject to more favorable royalty

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16.1 This Agreement shall commence on the Effective Date of this Agreement, and shall continue in full force and effect for the term of the last to expire Patent Rights unless this Agreement is earlier terminated as herein provided.

16.2 If LICENSEE shall fail to make any payment of a royalty owed to CHAMPION under ARTICLE III hereof or shall default in or breach any other term or provision of this Agreement, and also shall fail to remedy such default or breach within thirty (30) days after receipt of written notice specifying the default or breach and the particulars thereof from CHAMPION, then CHAMPION may at its option and in addition to any other remedies which it may have at law or in equity terminate this Agreement by giving written notice thereof to LICENSEE to such effect, in which event, this Agreement shall terminate on the thirty-first (31st) day after sending such notice.

16.3 LICENSEE shall have the right to terminate this Agreement upon thirty (30) days prior written notice to CHAMPION to such effect in the event that:

16.3.1 All the material claims of Patent Rights have been held invalid in a final unappealable judgment of a court of competent jurisdiction; or

16.3.2 A patent or proprietary right infringement dispute arises with respect to Patent rights between CHAMPION or its Subsidiary and a third party, based upon the facts of which an intellectual property attorney of ordinary skill in the art could conclude should be resolved in said third party's favor; or

16.3.3 Other material events or reasons making it impossible or unreasonable for LICENSEE to continue its performance under this Agreement.

16.4 No termination of this Agreement pursuant to this ARTICLE shall release either party from any obligations which have accrued prior to the effective date of termination including but not limited to obligations under ARTICLE III hereof to make payments due or which become due and under ARTICLE VII hereof to maintain the confidentiality of Confidential Information.

16.5 In the event that this Agreement is terminated pursuant to Paragraph 16.2, LICENSEE shall immediately cease the design, manufacture, sale and installation of CV² System, except where such design, manufacture, sale, installation, license or lease would not infringe a claim of Patent Rights which has not been held invalid in a final unappealable judgment of a court of competent jurisdiction.

16.6 If during the term of this Agreement, party shall become bankrupt or insolvent, or is subject to liquidation, or if the business of party shall be placed in the hands of a receiver or trustee, whether by the voluntary act of party or otherwise, or if party is obliged to make an assignment of assets for the benefit of creditors, or if party takes or is subject to any other action under law based on its inability to meet its financial obligations or if substantially all of party's assets are seized or attached in connection with any action against party or are sold or attempted to be sold, this Agreement shall terminate automatically without notice.

16.7 Failure on the part of CHAMPION to notify LICENSEE of any default or breach of this Agreement, or to terminate this Agreement because of any default or breach that would give CHAMPION the right to terminate, shall not constitute a condonation of such breach or default or a waiver of future breaches or defaults.

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ARTICLE XVII - SEVERABILITY

17.1 If any provision of this Agreement shall be held to be invalid, illegal or unenforceable, the validity, legality and enforceability of the remaining provisions shall not in any way be affected or impaired thereby.

ARTICLE XVIII - GOVERNING LAW

18.1 This Agreement shall be construed and the legal relations between the parties shall be determined, in accordance with the laws of the State of New York, without recourse to the conflict of laws of said State which would direct the use of laws of another jurisdiction. Any suit brought by either party against the other party on the basis of any controversy or claim arising out of or relating to this Agreement or a breach thereof shall be brought in the United States District Court for the Southern District of New York, and, if the United States District Court declines jurisdiction for any reason then in the Supreme Court First Department of the State of New York. The parties hereby consent to the personal jurisdiction of the courts and hereby designate the Secretary of State of the State of New York for receipt of service of process.

ARTICLE XIX - HEADINGS

19.1 The heading of each ARTICLE is inserted for convenience of reference only, and is not intended to be a part of or to affect the meaning or interpretation of this Agreement.

ARTICLE XX - AGREEMENT MODIFICATION

20.1 Any agreement changing the terms of this Agreement in any way shall be valid only if the change is made in writing executed by authorized representative of the Parties hereto.

ARTICLE XXI - COMMUNICATIONS

21.1 It shall be sufficient giving any notice, report, or other communication hereunder, if the party giving same shall deposit a copy thereof in the Post Office in a registered or certified envelope, by postage prepaid certified mail, or delivered by messenger or air courier addressed to the other party at the address provided hereinbelow or at such other address as may hereafter be designated in writing.

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If to CHAMPION:

For Business Matters:

Champion International Corporation
1 CHAMPION Plaza
Stamford, CT 06921

ATTN: Richard Piela
Director, Capital Project
Support and MRO

For Legal Matters:

Champion International Corporation
1 Champion Plaza
Stamford, CT 06921

ATTN: Richard C. Stewart, II
Chief Patent Counsel

If to LICENSEE:

Carotek Inc.
700 Sam Newell Road
P.O. Box 1395
Matthews, North Carolina 28106

ATTN: Addison Bell

Payments shall be made to the address indicated hereinabove for notices relating to business matters. The date of giving any such notice, invoice or other communication, and the date of making any such payment, provided that such payment is received, shall be the date on which such envelope is deposited. The Post Office receipt showing the date of such deposit shall be prima facie evidence of these facts.

ARTICLE XXII - ASSIGNABILITY

22.1 LICENSEE may not assign this Agreement without CHAMPION's express prior written consent by an authorized officer, provided, however, that LICENSEE may assign this agreement without CHAMPION's consent to the successor of LICENSEE's business provided that such successor agrees in writing to assume each and every duty and obligation of LICENSEE under this Agreement and to be bound to the terms and conditions of this Agreement to the same extent that LICENSEE is bound. A copy of the assumption agreement shall be promptly provided to CHAMPION.

22.2 CHAMPION may assign this Agreement and the rights granted to CHAMPION as CHAMPION in its sole discretion deems fit; provided, however, that if this Agreement is assigned to a competitor of LICENSEE or its Subsidiaries, LICENSEE shall have the right to terminate this

OCT-18-2006 23:49

P.43/61

terms than those set forth in ARTICLE III of this Agreement, CHAMPION shall promptly notify LICENSEE in writing of said more favorable royalty terms. Upon written request given by LICENSEE in writing within sixty (60) days after receipt of such notice, LICENSEE shall be entitled to the benefit of such more favorable terms as and from the date they became effective and only so long as they remain in effect with such third party; provided, however, that LICENSEE accepts all other applicable terms and conditions of such third party license; and provided further that in comparing royalty terms CHAMPION may assign a reasonable monetary value to any rights received from said third party by way of consideration for such third party license.

ARTICLE XIII- DISCLAIMER AND NEGATION OF AGENCY

13.1 It is agreed and understood by the parties hereto that LICENSEE is an independent contractor, and that nothing herein contained shall be deemed to create an agency, partnership, joint venture or like relationship between the parties. Neither party hereto is authorized or empowered to act as the agent for the other party for any purpose, and shall not on behalf of such other party enter into any contract, undertaking or agreement of any sort or make any promise, warranty or representation with respect to any matter.

13.2 It is mutually understood and agreed that any act or failure to act under this Agreement by or on behalf of LICENSEE or Subsidiaries of LICENSEE including but not limited to the design, manufacture, installation and use of and sale, lease, license or the transfer of CV² System is solely under the supervision, direction and control of LICENSEE or Subsidiaries of LICENSEE, and CHAMPION shall not be responsible for any such activities. LICENSEE assumes all responsibility for any and all warranties and for any and all costs, expenses, damages, judgments, claims and liabilities resulting from or arising out of any action or failure to take any action under this Agreement by or on behalf of LICENSEE or Subsidiaries of LICENSEE, and agrees to hold CHAMPION harmless, and to defend and indemnify CHAMPION, from any such costs, expenses, judgments, damages, claims or liabilities resulting from or arising out of the manufacture, installation, use or sale of CV² System, including but not limited to claims of patent or trade secret infringement or claims of customers, end-users, of the public or of any government or agency thereof, except in cases which are set forth in Paragraph 11.3 above.

ARTICLE XIV - PATENT MARKING

14.1 LICENSEE and Subsidiaries of LICENSEE shall mark all CV² System sold by them in the United States under the license granted herein with the words "U.S. Patent" or "U.S. Patents" and the number(s) of the Patent Rights applicable thereto, or with such other patent marking as CHAMPION may from time to time reasonably direct.

ARTICLE XV - GOVERNMENT MARKETING CLEARANCE

15.1 Prior to marketing any CV² System in any country, LICENSEE and Subsidiaries of LICENSEE shall have such System cleared for marketing by the responsible government agencies of that country requiring such clearance.

ARTICLE XVII - TERM AND TERMINATION

OCT-18-2006 23:49

P.47/61

Agreement forthwith by giving written notice thereof to CHAMPION and assignee and subject to the terms and conditions of Paragraphs 16.4 and 16.5.

22.3 Except as expressly provided in this ARTICLE XXII, any purported assignment shall be null and void.

ARTICLE XXIII - BINDING EFFECT - BENEFIT

23.1 This Agreement shall insure to the benefit of and be binding upon the parties hereto and their respective successors in interest and permitted assigns.

ARTICLE XXIV - ENTIRE AGREEMENT

24.1 This Agreement represents the entire understanding and agreement between the parties hereto with respect to the subject matter hereof, and supersedes all prior agreements, discussions and writings with respect thereto, either expressed or implied, between the parties.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be duly executed by their authorized representatives.

CHAMPION INTERNATIONAL
CORPORATION

By: Gerard P. Claret

Name: GERARD P. CLARET

Title: VICE PRESIDENT

CAROTEK INC.

By: J. Addison Bell

Name: J. ADDISON BELL

Title: CEO

EXHIBIT 2

STEIN, SPERLING, BENNETT, DE JONG, DRISCOLL & GREENFEIG, P.C.

ATTORNEYS AT LAW
25 WEST MIDDLE LANE
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www.steinsperling.com

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(301) 334-2200

WRITER'S DIRECT FAX
(301) 354-8110

WRITER'S E-MAIL ADDRESS:
jckwebster@steinsperling.com

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OF COUNSEL:
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WILLIAM J. SCOTT*

OUR FILE NUMBER
2071656-2

April 24, 2008

VIA FEDERAL EXPRESS

Sarah Manchester
Vice President Human Resources
& General Counsel
SAPPI Fine Paper
225 Franklin St. #28
Boston, MA 02110

Dear Ms. Manchester:

This law firm represents Kobayashi Ventures LLC ("KV"). KV is the owner of certain patents relating to web monitoring camera system technology, and has acquired certain License Agreements defining certain rights by licensees to use the patented technology, subject to those agreements.¹ This letter is in regard to KV's active litigation with Carotek Inc. ("Carotek") in the United States District Court for the New York Southern District (1:07-cv-11163-NRB), wherein my client has sued Carotek for Patent Infringement and Breach of License Agreement.

The subject patents encompass Technology² incorporated in web monitoring camera systems. Products protected under the patents take many forms including, but not limited to, integrated systems, parts, software, services and upgrades (the "Products"). KV is owned by Jim Dechman and John Fiore. Mr. Dechman and Mr. Fiore also manage Monitoring Technology Corporation (MTC).

¹ International Paper retains an entitlement to certain royalties collected by Kobayashi pursuant to those license agreements.

² Technology protected in the patents includes using two or more data collection devices (such as cameras) whose data stream is stored digitally with a control system utilizing sensors (such as break and/or machine speed sensor signals) which synchronizes the data capture and display with a process deviation event (such as a paper defect or web break). For a complete description of the Technology please refer to US Patents 6,211,905, 5,521,990 and 5,717,456.

STEIN, SPERLING, BENNETT, DE JONG, DRISCOLL & GREENFEIG, P.C.
 Sarah Manchester
 April 24, 2008
 Page 2

KV suspects SAPPI Fine Paper ("SAPPI") unwittingly may be using unlicensed Products, either acquired directly from Carotek, from a distributor, or from a third party, on its paper machines, off machine coaters or winders.

This would expose SAPPI to potential liability, since this product is not licensed for this purpose. It is in SAPPI's best interest to find out if this potential liability exists and to address it promptly. Carotek Inc. is no longer in the business of selling or servicing the Products on which it once paid royalties under the License Agreement. As such, SAPPI may find itself in the unfortunate position of ultimately being held legally and financially responsible for Patent Infringement.

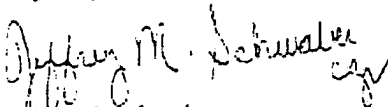
KV respectfully requests a list of all Products (as defined above) acquired from Carotek after December 8, 1998. By acquired we mean Products purchased, rented or loaned on trial basis, regardless of whether they are still in operation or have been replaced. Please provide the following:

- Mill address
- Machine identifier
- Date of installation and/or replacement

My client has no desire to disrupt the operations at your facilities. Your rapid response to this due diligence information request is vital to KV so that we may move forward quickly to resolve these issues. KV thanks you in advance for your cooperation. We respectfully request that SAPPI respond within seven (7) days of receipt of this letter.

Please feel free to contact me if you have any questions or concerns about this matter.

Very truly yours,


 Jeffrey M. Schwaber

JMS:cey
 \\CLIENTS\K\Kobryashi Ventures, LLC\Carotek\2007\correspondence\24-1 SAPPI\m.doc

EXHIBIT 3

STEIN, SPERLING, BENNETT, DE JONG, DRISCOLL & GREENFEIG, P.C.

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OUR FILE NUMBER
2071656-2

April 24, 2008

VIA FEDERAL EXPRESS

Mark Mosher
Vice President of Pulp & Paper
J.D. Irving, Limited
300 Union Street
Saint John, NB
E2L 4M3
Canada

Dear Mr. Mosher:

This law firm represents Kobayashi Ventures LLC ("KV"). KV is the owner of certain patents relating to web monitoring camera system technology, and has acquired certain License Agreements defining certain rights by licensees to use the patented technology, subject to those agreements.¹ This letter is in regard to KV's active litigation with Carotek Inc. ("Carotek") in the United States District Court for the New York Southern District (1:07-cv-11163-NRB), wherein my client has sued Carotek for Patent Infringement and Breach of License Agreement.

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STEIN, SPERLING, BENNETT, DE JONG, DRISCOLL & GREENFEIG, P.C.

Mark Mosher

April 24, 2008

Page 2

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This would expose J.D. Irving to potential liability, since this product is not licensed for this purpose. It is in J.D. Irving's best interest to find out if this potential liability exists and to address it promptly. Carotek Inc. is no longer in the business of selling or servicing the Products on which it once paid royalties under the License Agreement. As such, J.D. Irving may find itself in the unfortunate position of ultimately being held legally and financially responsible for Patent Infringement.

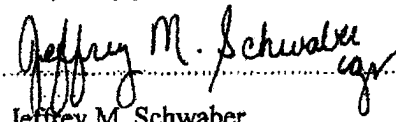
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My client has no desire to disrupt the operations at your facilities. Your rapid response to this due diligence information request is vital to KV so that we may move forward quickly to resolve these issues. KV thanks you in advance for your cooperation. We respectfully request that J.D. Irving respond within seven (7) days of receipt of this letter.

Please feel free to contact me if you have any questions or concerns about this matter.

Very truly yours,



Jeffrey M. Schwaber

JMS:cgv

L:\CLIENTS\K\Kobayashi Ventures.LLC\Carotek.002\correspondence\54-1 J.D.Irving.ltr.doc

EXHIBIT 4

VIDEOTAPED DEPOSITION OF JAMES ADDISON BELL
CONDUCTED ON MONDAY, MAY 12, 2008

12

1 company called ECS?

2 A. When?

3 Q. At any point?

4 A. Yes.

5 Q. And what is the full name of ECS?

6 A. Event Capture Systems, Incorporated.

7 Q. When was it formed?

8 A. It was incorporated, I believe,
9 November 2007.

10 Q. Was it formed prior to its
11 incorporation -- to its formal incorporation?

12 A. Its genesis goes back to December 2006.

13 Q. And what was the genesis?

14 A. In 2006 Carotek decided to get out of
15 the ECS business. And we were approached by one of
16 the salesman in the company to take over the
17 business.

18 Q. Who is that?

19 A. John Larkin.

20 Q. When you say we were approached, who
21 was approached?

22 A. Carotek.

EXHIBIT 5

**IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF NEW YORK**

CAROTEK, INC.,
Plaintiff,
v.
KOBAYASHI VENTURES, LLC,
Defendant.

EVENT CAPTURING SYSTEMS, INC.
Plaintiff,
v.
KOBAYASHI VENTURES, LLC,
Defendant.

DECLARATION OF EDDY C. TAM

Eddy Tam, after having first been duly sworn in accordance with law, does hereby declare pursuant to 28 U.S.C. § 1746:

1. My name is Eddy C. Tam. I graduated from the State University of New York College at Buffalo with a Bachelor of Science in Physics, and from Penn State University with a Ph.D in Electrical Engineering. I have worked at Carotek, Inc., from July 1, 2000 until December 31, 2007, and at Event Capture Systems, Inc., since January 1, 2008. I am well experienced in Event Capturing Systems and I have personal knowledge of the facts described herein.

2. The ECS Monitoring System is a monitoring system used for monitoring the

production of paper in a manufacturing facility. The ECS Monitoring System allows an operator to review the production process if a paper break occurs.

3. The ECS Monitoring System provides multiple cameras positioned about a manufacturing line and the cameras are configured to record the manufacturing of a product. At the instance when a paper break occurs, at least one trigger is positioned about the manufacturing line and is configured to output a signal when a deviation is detected. The signal that is output by the trigger is a simple 0/1 logic signal, and outputs 0 under normal operating conditions and 1 when the trigger is initiated.

4. An ECS Monitoring System computer records video continuously and saves the video in file segments on a computer's hard disk. Each file segment is of a fixed time length (called the pre-event time) that corresponds to the total time for the paper to travel from the beginning to the end of a paper machine. For example, if the total travel time along the machine is 30 seconds, then each video segment is 30 seconds long.

5. Upon receiving a trigger signal, the video segment in recording will continue to record for a predetermined additional amount of time (called the post-event time). The ECS Monitoring System then time-stamps the trigger signal and simply renames the current segment and the previous segment from the existing video buffer using the timestamp as the main body of the file name structure.

6. The deviation file is saved within the exact same physical hard drive as a non-deviation event file would be saved. Each of these segments are saved in a video buffer ring of a predetermined length. Once the video buffer ring has reached storage capacity, the oldest video segment is cycled out and saved over by the newest segment. The ECS Monitoring System will not record over a video segment corresponding to a deviation event because these segments are automatically time stamped and renamed to a different directory on the recording hard drive. In this manner, the ECS Monitoring System has no uncertainty about which segment of video data contains the deviation event; the ECS Monitoring System only saves the video segment corresponding to the deviation event and the previous time segment.

7. For ECS Monitoring Systems with multiple cameras, multiple computers are connected to an ECS Monitoring System master computer. As the master computer receives the

trigger signal, video files corresponding to the event trigger time are saved from each camera, and collectively these video files form an ECS Monitoring System paper-break event.

8. This event is available for the operator to review at any time. There is no need to look for and then extract the relevant image frames from the video buffer in each of the recording computers because any relevant image frames from that video camera related to this paper break event must be included in the two renamed video files from each computer. As an event is loaded on a video window, video files from each camera are loaded onto different video windows.

9. The camera associated with the trigger source is called the anchor camera and is loaded first and then the video frame at event trigger time is displayed. The remaining cameras are opened up based on a linear sequencing logic in different video windows at a time frame offset from the anchor camera so that the image frame shown in each window is time-offset based on the relative locations of this camera as compared with the anchor camera along the paper machine. Alternatively, the operator may open each additional image frame on the same video windows. Each video monitor window plays a file corresponding to the camera associated with that video window, and the operator of the ECS Monitoring System will have to view multiple files to view the monitoring sequence.

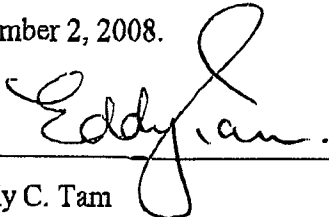
10. The video data is presented in multiple video windows where users can freely play the multiple video segments forward or backward, or navigate to any frame within the pre-event to the post event range. Not only is the event handling for the video in the video buffer is different, the way of presentation between an ECS Monitoring System and the Champion system is also different.

11. Unlike the Champion Patents which require that each monitoring sequence be extracted from each hard drive and then spliced together to form one continuous video, there is no splicing of data clips together to form one video file.

12. The ECS Monitoring System uses a recording clip having a length only about as long as the time required to run one manufacturing cycle, and, therefore, no extraction is necessary from a larger video segment since the recording clip is already in a suitable length, i.e. a length long enough to cover one cycle of the manufacturing process. For this same reason, the ECS Monitoring System does not have to identify the segment corresponding to the deviation

event.

I, Eddy Tam, declare under penalty of perjury that to the best of my knowledge the foregoing is true and correct. Executed on September 2, 2008.



Eddy C. Tam

EXHIBIT 6

United States Patent [19]

Rudt et al.

[11] **Patent Number:** 5,717,456[45] **Date of Patent:** Feb. 10, 1998[54] **SYSTEM FOR MONITORING A
CONTINUOUS MANUFACTURING PROCESS**[75] **Inventors:** Robert J. Rudt, Highland Mills, N.Y.;
Leonard F. Fiore, Foley, Minn.;
Kenneth D. Grapes, Indian Springs,
Ohio[73] **Assignee:** Champion International Corporation,
Stamford, Conn.[21] **Appl. No.:** 399,235[22] **Filed:** Mar. 6, 1995[51] **Int. Cl.⁶** H04N 7/18[52] **U.S. Cl.** 348/88; 348/86; 348/125[58] **Field of Search** 348/88, 86, 8,
348/92, 125, 128, 94; H04N 7/18[56] **References Cited****U.S. PATENT DOCUMENTS**

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WO 96/27864	9/1996	WIPO	G08B 15/00

OTHER PUBLICATIONS

Video Surveillance Trouble Shooting at I.S.P.I. 1994 Engineering Conference p. 531 J.A. DeWitte et al.

Primary Examiner—Tommy P. Chin

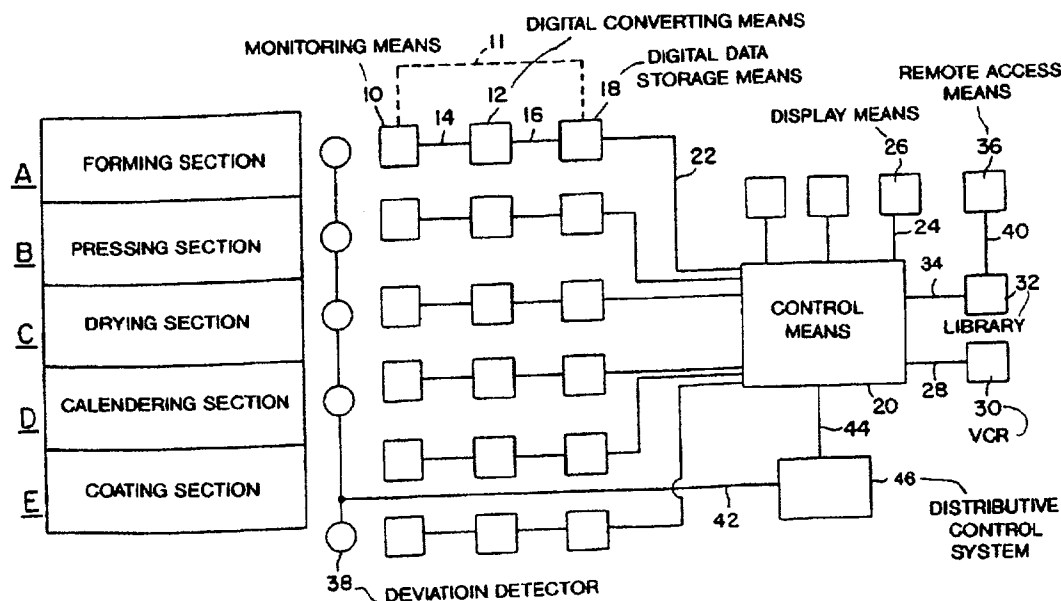
Assistant Examiner—Vu Le

[57]

ABSTRACT

The invention is a system for monitoring a process in which process data relating to a predetermined characteristic of the process is collected and stored in digital format and extracted based upon a predetermined criterion for display. A plurality of monitors are strategically positioned at various locations of interest to observe the predetermined characteristic. Data obtained by the monitors are converted into digital format and stored. A central control is provided for retrieving the digital data in accordance with a predetermined criterion and transmitting the retrieved data to a display unit. The predetermined criterion for display may be specified as a deviation from the predetermined characteristic, and a plurality of deviation detectors may be coupled to the system for obtaining and relaying information relating to such deviations. Upon deviation, the central control may be adapted to retrieve digital data based on time and location of the deviation.

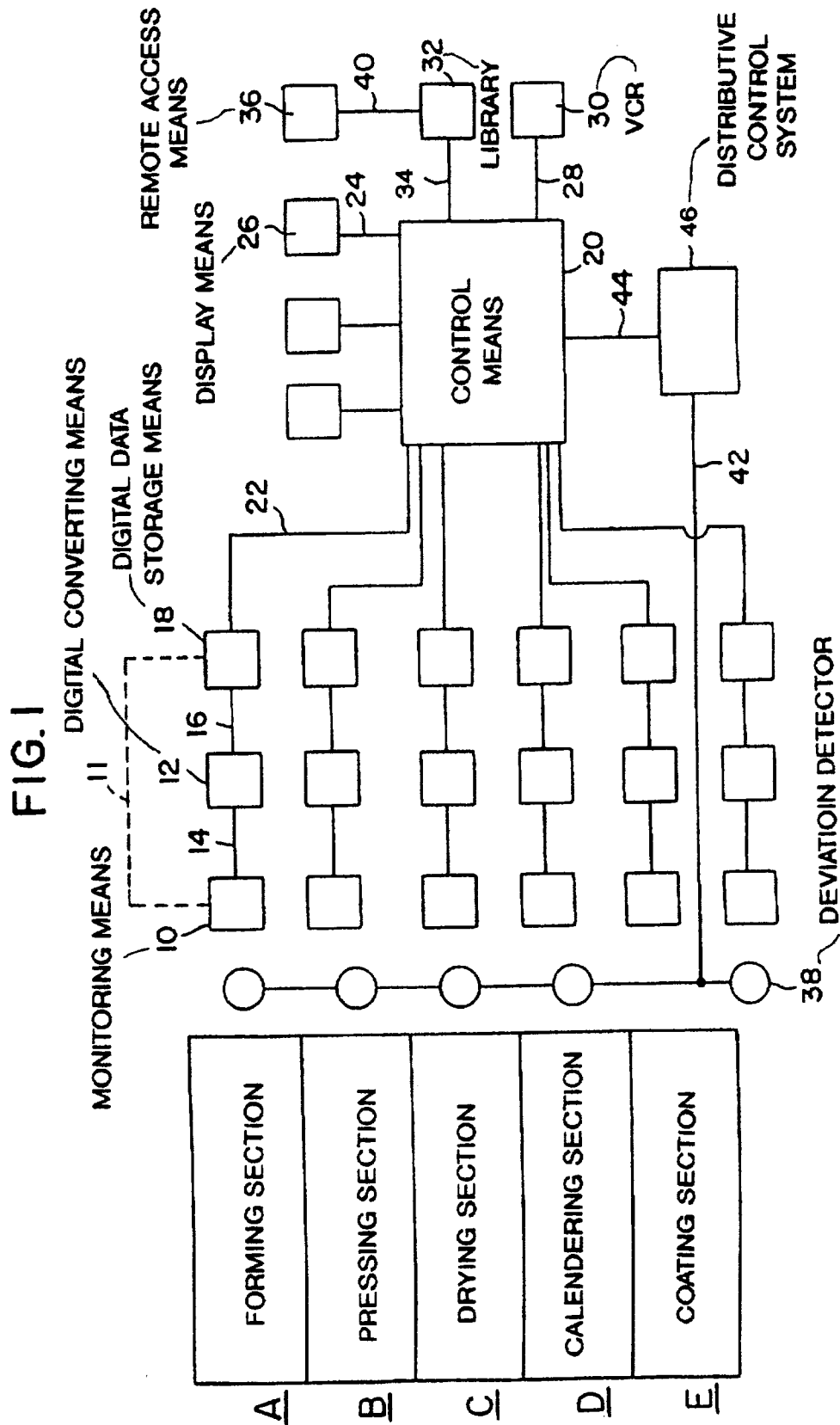
19 Claims, 1 Drawing Sheet



U.S. Patent

Feb. 10, 1998

5,717,456



5,717,456

1

SYSTEM FOR MONITORING A CONTINUOUS MANUFACTURING PROCESS

BACKGROUND OF THE INVENTION

I. Field of the Invention

This invention relates generally to a system for monitoring a process. More particularly, this invention relates to such a system in which process data relating to a predetermined characteristic of the process is collected and stored in digital format and extracted based upon a predetermined criterion for display.

II. Description of the Prior Art

Processes are known for the continuous production or handling of a product. Illustrative of such processes are those for the production or handling of continuous products, as for example polymeric films, paper webs, metallic webs, roll printing processes and the like. Other such processes include those for production or handling of discrete products such as sheet printing processes, packaging processes and the like.

A desired objective of these processes is that the product have certain pre-determined characteristics, as for example characteristics which insure that the product is of acceptable quality. A failure to detect and correct deviations from these pre-determined characteristics is an extreme disadvantage adversely affecting the economics of the process as for example because of lost production time, discarding of unacceptable product, and the like.

As a result, systems for inspecting and observing the product by continuous processes have been developed. See for example the systems described in U.S. Pat. Nos. 4,951, 223; 4,814,869; 5,239,376; and the like. These systems usually involve the monitoring through use of one or more video cameras strategically placed along the production line, storage of video output on video tapes, means for shutting down production of the product in the event of deviations from pre-determined characteristics and playback of video tapes to determine the cause of the deviations so that corrections can be made in a timely fashion. These known monitoring systems suffer from one or more disadvantages which adversely affect their performance. For example, these prior processes are manual and require re-winding of the tape which results in down time of the system and long processing times. Moreover, tapes often degrade and it is difficult to access those portions of the tape containing relevant information or to make good copies. In these systems the tapes are not networked or tied together and the system cannot simultaneously recorded and played back. The system of this invention obviates one or more of these disadvantages.

SUMMARY OF THE INVENTION

This invention provides a monitoring system for continuously monitoring the operations of a machine for the continuous manufacture of a product. More particularly, the system of this invention comprises:

a plurality of monitoring means for continuously monitoring a pre-determined characteristic of the process and collecting monitored data, each monitoring means addressing a different location of interest of said process, and capable of monitoring and collecting real time data relative to said location;

data converting means for converting said output data into digitized data;

digital data storage means capable of storing segments of said digitized data, each of said segments comprised of

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a plurality of digitized data clips, said segments and said clips of predetermined lengths which cover the operations of said process at a relevant location over a predetermined period of time, said digitized data segments being stored such that as new digitized data is stored in said segment, the earliest prior stored digitized data in said segment is displaced from said segment to maintain said segment at said predetermined length; and

control means for controlling said monitoring system, said control means in communication with said digital data storage means and capable of extracting one or more digitized data clips according to predetermined criterion to form one or more extracted clips, and capable of displaying said extracted clips.

As used herein, "compression" means applying data reduction means such as an appropriate algorithm, technique, technology or the like to digitalized data for a real time event at a location in a process to reduce the amount of digitized data required to recreate the event. As used herein, "process" means an action, change or function or a series of actions, changes or functions that bring about a result or end, as for example a system of operations in the production of something. As used herein, "clip" means a digitalized data series for a location of a process during a pre-determined period of time. As used herein, "digitized" or "digitization" means to convert to or to collect in a digital format as for example conversion of an analog signal of a visual image to a digital format or collection of a visual image directly into a digital format. As used herein, "digital" means information in a binary format, or zeros and ones, usual for storage in a digital data storage means such as a computer. As used herein, "segment" means a portion of the digital data storage means containing one or more digitized data clips.

In a preferred embodiment of the invention, said process is a continuous process for the manufacture of a product, and said deviation event is a deviation in a pre-determined characteristic of said product.

In a more preferred embodiment of the invention, the system comprises a plurality of storage means, each of which comprises at least one digitized data segment, at least one of said storage means capable of storing digitized data monitored and collected from first monitoring means at a first location of the process and at least one of said storage means capable of storing data monitored and collected from a second monitoring means at a second location of the process. Preferably, the control means is capable of extracting clips from segments stored in two or more of said plurality of said storage means such that said extracted clips are time synchronized to chronologically show the pre-determined characteristic of a single discrete product or a portion of a continuous product as said product passes by each location of the digitized data in said extracted clips. Alternatively, the control means is capable of extracting the event clip recording said event and the clip immediately preceding said event clip from the segment containing data from a single location of the process, and optionally the data clip immediately following the event clip, splicing said clips in chronological order to form a display clip and displaying said display clip.

In another preferred embodiment, the process comprises a plurality of steps and wherein there is at least one monitoring means, data converting means and data storage means for said step.

In still another preferred embodiment, the process is controlled by a distributive control system in communication with said control means, said control system having one

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or more deviation detectors for monitoring said pre-determined characteristic, each of said detectors addressing a different location of interest along the process and capable of detecting deviation events and communicating a signal of said deviation event, and the time and location of said event to said control means;

wherein on receipt of said deviation event signal said control means capable of identifying data storage means containing the digitized data segment corresponding to said deviation event, extracting the deviation event clip and displaying said display clip, and wherein said distributive control system is preferably capable of communicating process data relating to the operation of the process and the time of break to said control means.

In yet another preferred embodiment, the control means is capable of extracting the event clip recording said event and the clips immediately preceding and optionally the clip immediately following said event clip, splicing said clips into a display clip chronological order and displaying said display clip.

A most preferred embodiment of this invention relates to a monitoring system for monitoring the manufacture of a continuous web of paper having one or more pre-determined characteristics in a paper manufacturing machine comprising:

a plurality of monitoring means which comprises one or more video cameras for monitoring the paper web, each monitoring means addressing the paper web at a different location of interest along the paper manufacturing machine and capable of producing a video image of the paper web at the location;

digital converting means for converting the video image into a digitized video signal;

digital data storage means capable of receiving said digitized video signal and storing digitized segments thereof, each of which comprises a plurality of digitized clips, said digitized segments and clips of a predetermined length covering real time operation of said machine, said digitized segments being stored such that the earliest prior stored digitized data in said segment is displaced as new digitized data, is stored in said segment to maintain said stored segment at said predetermined length;

Computer control means for controlling the operations of said system, said means in communication with said digital data storage means and capable of controlling same, said computer control means in communication with a distributive control system for controlling said machine, said system having one or more deviation detectors for detecting deviations from predetermined characteristics as said paper web passes through said machine said control system capable of communication process master time and date information to said computer control system; and

one or more video monitors in communication with said computer control means and capable of displaying the image of digitized video signals under the control of said computer control means;

wherein on occurrence of a deviation from the predetermined characteristics of said web, said distributive control system transmits a deviation signal comprising the time, date and location of said deviation event to said computer control means, and in response thereto said computer control means identifying the digitized data segment corresponding to said deviation event,

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extracting the deviation event clip, the preceding clip preceding said break event clip to form a display clip and displaying said display clip on a video monitor.

The system of this invention obviates one or more disadvantages of prior art monitoring systems. For example, There no loss or substantially no loss of data due to rewinding, no or substantially no deterioration in the stored data and good copies of the data can be made. The system can be easily used in an automatic mode and allows simultaneous observation and collection/storage of data. The system allows the monitoring of the process from a central location or from one or more other locations, and allows correlations between collected/recorded data and other process operations data.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention and the advantages attendant thereto will become apparent upon a reading of the following detailed description of the invention taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a depiction of a preferred embodiment of this invention showing a schematic of a paper making machine, including a possible configuration of surveillance cameras and web failure detection devices.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is directed to a system for monitoring a machine or process for manufacture of a product. While the preferred embodiment of FIG. 1 depicts the system in use to monitor a paper manufacturing process and machine. The nature of the process may vary provided that the process has a pre-determined characteristic. The process may be batch, semi-continuous or continuous, or automatic or manual. For example, the process may monitor people or things entering or leaving a building or a room in a building or a process for the manufacture or handling of discrete or continuous products. In the preferred embodiments of the invention, the process is for the manufacture or handling of a product. Processes for manufacturing and handling discrete products include processes for extruding, packaging, filling, bottling, sheet fed printing, conveying, converting, wrapping, stamping, or assembling a discrete product. Processes for manufacturing or handling a continuous product include those for the manufacture of a continuous web material such as a polymeric or metal sheet or film, printed paper, carpet, woven material, non-woven material, textile material or photographic film which has certain predetermined characteristics which must not be deviated from. The system can be conveniently used to monitor the manufacture of such continuous or discrete products to monitor for any deviations from the desired pre-determined characteristic(s).

The system is especially useful in paper manufacture as depicted in more detail in FIG. 1. FIG. 1 depicts a schematic representation of a paper making machine in which the wet end forming section is at the top and the final product section is at the bottom. As depicted in the figure, the machine consists of five sections, denoted by A, B, C, D and E. A denotes the forming section; B denotes the pressing section; C denotes the drying section; D denotes the calendaring section; and E denotes the coating section. As shown on FIG. 1, monitoring means 10 are strategically positioned at various locations of interest along the paper making machine. Observing means 10 may vary widely and depends on a pre-determined characteristic of the product being monitored for deviation events. Illustrative of useful observing

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means are those which employ coherent or non-coherent visual, gamma, infra-red, ultraviolet, thermal and nuclear radiation, sonics, ultrasonics, magnetic fields, pressure, odor and the like. The particular observing means 10 used in any particular situation will normally depend on the pre-determined characteristics of the product being observed and the event which indicates a deviation from the pre-determined characteristic. For example, if the pre-determined characteristic is continuity of the web of paper and the deviation is a break or hole in the web, then monitoring means which employs visual radiation such as a video camera can be conveniently employed. On the other hand, if the pre-determined characteristics are moisture content, surface texture, color, gloss and the like monitoring means which involve the use of visual and infra-red radiation may be used.

In the preferred embodiment of this invention depicted in FIG. 1, monitoring means is a plurality of video cameras 10. While seven cameras 10 are depicted in the figure, the number of cameras employed may vary widely, and any number capable of providing the desired degree of monitoring can be employed. The positioning of various monitoring means 10 may vary widely depending on the needs of the user. In the preferred embodiment depicted in FIG. 1, where the pre-determined characteristic of the web being monitored is web continuity and deviations in this characteristic being detected are break events, hole events or a combination thereof, the number of cameras 10 and camera positions are such that locations where breaks are most likely to occur are covered. For example, as depicted in FIG. 1, cameras 10 are positioned at the drawing section, coating section, size pressing section, center rolls section, sheet pick-up section and reeling device section.

The system of this invention also includes digital converting means 12 for converting data obtained or generated by monitoring means 10 into a digital format. Digital converting means employed may vary widely and any such means capable of performing this function may be used. Illustrative of suitable digital converting means 12 are electronic circuit boards, converting signal processors, video boards, micro-chips, and assorted software. The number of digital converting means 12 and the relationship of digital converting means 10 to monitoring means 10 may vary widely, the only requirement is that relevant monitored data is eventually converted into digital format. For example, there may be a single digital converting means 12 for each monitoring means 10 or there may be one or more digital converting means 12 for all monitoring means 10 or various other combinations of converting means 12 and monitoring means 10 may be employed. Digital converting means 12 and monitoring means 10 may be separate devices as depicted in FIG. 1, or these functions may be performed by the same device as for example a digital video camera 10 which directly monitored data in a digital format, which data is conveyed directly to digital data storage means 18 via conductor 11.

As depicted in FIG. 1, each video camera 10 monitors the web and monitored data is generated in an analog format. The analog data is then conveyed to digital converting means 12 via conductor 14 where the analog data is converted to digital format by digital converting means 12, with or without data compression. The digitized data is then conveyed via conductor 16 to digital data storage means 18.

The specific digital data storage means 18 may vary widely provided that such means allows storage of segments of digitized data having a pre-determined length which covers data obtained by monitoring means 10 which cover

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the real time operations of the machine over a predetermined period of time. The segment, in turn, is comprised of a plurality of digitized data clips which are also of a pre-determined length which also cover the real time operations of the machine over a predetermined period of time. The segments and clips are in chronological order and are preferably identified by date and time at which the data was collected which greatly facilitates access to relevant data clips on occurrence of a deviation event. Preferably, the clips are also stored such that clips can be readily identified by time and date, and can be extracted or copied from the segment. A further requirement of the digital memory storage means 18 is that it can be controlled by a control means 20 such that specific clips can be extracted from the digital data storage means 18 as desired and as will be described hereinbelow in more detail. In the operations of the digital data storage means 18, the segment is maintained at or about the pre-determined length during the operations of the system such that as new digitized real time data is added to digital data storage means 18, the oldest or most prior data is erased, deleted or otherwise removed from storage means 18 maintaining said segment at or about some pre-determined length. The advantages of this storage means 10 becomes readily apparent in that stored digital data showing normal operations to produce the product having the pre-determined characteristic is constantly removed from storage means 18 such that upon storage of deviating digitized data of a deviation from the pre-determined characteristic, as for example a break event, such deviating data can be more easily isolated from the relatively small amount of data comprising the segment.

The pre-determined length of the segment and the clips may vary widely initially and during the operation of the system, usually depending upon function and capacity of the digital data storage means, duration of the deviation event and the like. The length of the segments are preferably less than about 60 minutes, more preferably from about 15 to about 60 minutes, and most preferably from about 15 to about 30 minutes. The length of the clips comprising a segment is preferably less than about 60 secs., more preferably from about 5 to about 60 secs., more preferably from about 5 to about 20 to 30 secs and most preferably from about 5 to about 10 secs.

The digitized data storage means 18 utilized in any particular situation may vary widely. Illustrative of useful data storage means 18 are hard drive, tape, diskette, CD rom, magnetic optical drive, solid state memory, flash memory, optical device, and the like. Preferred digitized data storage means 18 are hard drives and CD roms. As depicted in FIG. 1, the most preferred digitized data storage means 18 is a hard drive and is in communication with control means 20 by way of connector 22. Control means 20 functions to control the system. Useful control means 20 may vary widely, the only requirement is that means 20 is in the event of a deviation event able to locate the data clip containing data of such event, to extract such data clip and to display said data clip. Illustrative of useful control means 20 are analog control system and a digital computer.

As depicted in FIG. 1, control means 20 is a digital computer which communicates via connector 24 to a plurality of display means 26 which in the embodiment of FIG. 1 are video monitors. Useful display means 26 may vary widely the only is that such means is capable of displaying data to the satisfaction of the operator. Other useful display means 26 are printers, projection systems, photographic imagers and the like. Also connected to control means 20 by way of cable 28 is for example a VCR 30 for recording for

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wider distribution of data and a library 32 for storage of data by way of cable 34. As depicted in the figure, library 32 can be accessed from various locations by remote access means 36 such as a local area network, wide area network, e-mail services, satellite, compact disk and the like connected to library 32 via cable 40.

FIG. 1 also depicts a plurality of deviation detectors 38 strategic positioned along the machine in a well known manner to detect deviations in the pre-determined characteristics in the product being monitored. Detectors 38 are connected to the machine control or distributive control system 46 via cable 42 for transmission of a deviation signal to system 46. System 46 also communicates with control 20 via cable 44 such that various information can be transmitted to control 20 from system 46 in the event of a deviation from the pre-determined characteristic as for example a break in a web. Such information includes the detection of a deviation event, time of detection of the deviation event and such other process data relating to the operations of the machine at the time of deviation event deemed appropriate.

In operation, monitoring means 10 continuously monitors a pre-determined characteristic of the product being produced by the machine. The monitored data is conveyed via cable 14 to digital conversion means 12 where the data is converted to a digital format, and the digitized data is conveyed to digital data storage means 18 via cable 16 for storage. In those embodiments of the invention where the monitored data is collected in digital format by monitoring means 10, as for example by a digital video camera, the digitized data is converted directly to digital data storage means 18 via cable 11. During operations where there are no deviations from the pre-determined characteristics, digitized data flows continuously into storage means 18 such that only a pre-determined amount of data converting a pre-determined period of time during the operation of the machine is always maintained in storage and that as new data is stored the oldest or most prior data is deleted or erased.

If a deviation in the pre-determined characteristics of the product occurs, it is detected by a deviation detector 38. Detector 38 sends a deviation signal to distributive control system 46 via cable 42, and the signal is relayed to control means 20 via cable 44. In addition to a deviation signal, detector 38 may also inform control system 40 of the identity of detector 38 detecting the deviation event, the time of the deviation event and location in the process of the deviation event. This information together with other process data such as type of product being manufactured, machine operation parameters, machine speed, draw ratios, furnish, types, additives, coating components, calendaring pressures, coating thickness, basis weight of the paper and the like are conveyed to control means 20. On receipt of the deviation event signal, control means 20 is capable of identifying the clip most likely to have digitized data relating to the deviation event, and extracting such clip and displaying the extracted clip with display means 26. For example, control means 20 can perform this function by coordinating the time at which deviation event detector 38 detected the deviation event with the clip or clips corresponding in time. This coordination can be done in any suitable manner. For example, control 20 can scan all digitized data storage means 18, select clips from all means 18 containing data collected at the appropriate time and can then scan each clip to identify the deviation event and display same. Alternatively, control means 20 can identify the monitoring means 10 most proximate to the location of the deviation event, select a clip or clips from the digitized data storage

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means 18 for such monitoring means 10 and display such clip. In order to insure that all suitable data is displayed in the fastest possible time, preferably control means 20 will also extract digitized data clips immediately preceding and following the clip or clips most likely containing data for the deviation event and will splice the deviation event clip and the following and preceding clips into a display clip for display. By splicing the event, preceding and following clips, the operation of the machine prior to, during and subsequent to the deviation event can be observed. After a deviation is detected, the machine is usually stopped and the digitized data storage means 18 is frozen to prevent loss of critical data.

The clips can be displayed automatically or manually at any suitable speed. The clips can be displayed frame by frame, in various sizes. The clips can also be viewed in reversed mode. This function combined with a pause, play-back and resizing can enhance the ability of the operators to locate the exact point of interest on the display clip, for study showing the deviation event as it occurred. Of course, many other functions may be provided by control means 20 including zooming, edge enhancement, image sharpening, gradient edge enhancement, de-specking, filtering, cropping, desizing, dithering, interpolation, image intensity, format conversion, color inversion, contrast control, brightness control, embossing and the like. Manual/automatic control of all functions may be provided.

In this manner, the control means 20 becomes the driver which also manages the logistics of the system including monitoring, displaying, storage, etc., and can additionally be used to supervise the status of each device in the system as desired. In addition, other peripherals can be provided as needed.

The ability to review the critical period just prior to the deviation event at any desired speed provides the input necessary to evaluate the cause of the problem so that necessary adjustments and/or repairs can be started quickly and the machine restored to normal operation. If only a defect in the product is to blame, this, too, often will show up. In this manner, valuable time can be saved.

The clip or clips covering the deviation event are displayed, the cause of the deviation event can be discovered and appropriate action can be taken to correct the cause of the event. The process or machine and the monitoring system can then be reactivated.

The clips relating to the deviation event together with any other process data associated with the deviation event are conveyed via line 34 to library 32 for storage. In this manner, a collection of deviation clips and associated process data is formed which can be accessed by remote access 36 via connector 40 for suitable purposes as for example for accessing, and correlating or otherwise evaluating accessed data based on or more variables such as process times, properties, products, types or modes of deviation events, recorded observations, types of machines, and like process or product characteristics, and to document machine or process defects such as a hole in the felt or wire. The clips and associated process data may also be conveyed via connector 28 to video recorder 30 for storage on a video tape.

This invention has been described in this application in considerable detail in order to comply with the Patent Statutes and to provide those skilled in the art with the information needed to apply the novel principles and to construct and use such specialized components as are required. However, it is to be further understood that the

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invention can be carried out by specifically different equipment and devices and that various modifications both as to equipment and procedure details can be accomplished without departing from the scope of the invention.

What is claimed is:

1. A monitoring system for monitoring the manufacture of a continuous web of paper having one or more predetermined characteristics in a paper manufacturing machine comprising:

a plurality of monitoring means which comprises one or more video cameras for monitoring the paper web, each monitoring means addressing the paper web at a different location of interest along the paper manufacturing machine and for producing a video image of the paper web at the location;

digital converting means for converting the video image into a digitized video signal;

digital data storage means for receiving said digitized video signal and storing digitized segments thereof, each of which comprises a plurality of digitized clips, said digitized segments and clips of a predetermined length covering real time operation of said machine, said digitized segments being stored such that earlier prior stored digitized data in said segment is removed as new digitized data is stored in said segment to maintain said stored segment at or about said predetermined length;

computer control means for controlling the operations of said monitoring system, said means in communication with said digital data storage means, said computer control means in communication with a distributive control system for controlling said machine, said control system having one or more deviation detectors for detecting deviations from predetermined characteristics as said paper web passes through said machine; and one or more video monitors in communication with said computer control means and for displaying the image of digitized video signals under the control of said computer control means;

wherein an occurrence of a deviation from the predetermined characteristics of said web, said distributive control system transmits a deviation signal comprising the time, date and location of said deviation event to said computer control means, and in response thereto said computer control means identifying the digitized data segment corresponding to said deviation event, extracting the deviation event clip, the preceding clip preceding said break event clip to form a display clip and displaying said display clip on a video monitor.

2. System of claim 1 wherein at least one digital converting means is in communication with at least one video camera and at least one digital data storage means is in communication with at least one digital converting means.

3. System of claim 2 wherein on receipt of said deviation event signal at the time of said deviation, said computer control means identifies a video camera proximate to said deviation detector detecting said deviation event, freezes operations of digital memory storage means for such camera, identifies the digitized data segment corresponding to said deviation event by correlating the time of said segment with the time of said deviation event, extracting the deviation event clip which correlates to the time of said deviation event and the preceding clip preceding said deviation event clip and the subsequent clip following said deviation event clip, splicing said deviation event clip, said preceding clip and said subsequent in chronological order to form a display clip and displaying said display clip on said video monitor.

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4. System of claim 3 which further comprises:
means for transmitting process data from the distributive control system with said break event signal;
library means for storage of display clips and associated process data; and
means for accessing said display clips and process data stored in said library.

5. System of claim 1 wherein said event is selected from the group consisting of a break in said web, a hole in said web and a change in a surface characteristic of said web.

6. System of claim 1 wherein said computer control means is also for controlling said digital data storage means.

7. System of claim 1 wherein said distributive control system is also for communicating process master time and date information to said computer control system.

8. A monitoring system for continuously monitoring a process for the manufacture of a product, said process comprising:

a plurality of monitoring means for continuously monitoring a pre-determined characteristic of the process and collecting monitored data, each monitoring means addressing a different location of interest of the process, and each said monitoring means for monitoring and collecting data in real time relative to said location;

data converting means for converting said collected data into digitized data;

digital data storage means for storing segments of said digitized data, each of said segments comprised of one or more digitized data clips, said segments and said clips of pre-determined lengths which cover the operations of said process at a relevant location over a pre-determined period of time, said digitized data segments being stored such that as new digitized data is stored in said segment, earlier prior stored digitized data in said segment is removed from said segment to maintain said segment at or about said pre-determined length;

a distributive control system for controlling the process, said control system having one or more deviation detectors for monitoring said pre-determined characteristic and for detecting deviation events in said pre-determined characteristic, each of said detectors addressing a different location of interest along the process and for transmitting a signal of said deviation event, and the time and location of said event; and

control means in communication with said control system and said digital data storage means, said control means for controlling said monitoring system and for extracting one or more digitized data clips on receipt of said deviation event signal to form one or more extracted clips, said control means also for identifying data storage means containing said digitized data segment corresponding to the time and the location of said deviation event, for extracting said deviation event clip to form a display clip and for displaying said display clip.

9. System of claim 8 wherein said process is a continuous process for the manufacture of a product.

10. System of claim 9 wherein said process comprises a plurality of steps and wherein there is at least one monitoring means for each of said steps.

11. System of claim 8 wherein a plurality of monitoring means address a single location, each in communication with a digital data converting means which is in communication with a digital data storage means, said control means extracts one or more digitized data clips from each of said storage means and displays said extracted clips.

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12. A system of claim 11 wherein each of said monitoring means monitors a different pre-determined characteristic.

13. A system of claim 12 wherein said monitoring means are different.

14. System of claim 8 wherein said distributive control system is also for communicating process data relating to the operation of the process to said control means.

15. System of claim 14 which further comprises:

library means in communication with said control means for storage of display clips and process data relating to the operation of the machine at the time of deviation, said library also for display of said stored display clips and process data.

16. System of claim 15 wherein said control means extracts the event clip recording said event and the clip

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immediately preceding said event clip, splicing said clips in chronological order to form a display clip and displaying said display clip.

17. System of claim 16 wherein said control means extracts the event clip recording said event, the clip immediately preceding said event clip, the clip immediately following said event clip, splicing said clips in chronological order to form a display clip and displaying said display clip.

18. System of claim 8 wherein said pre-determined criterion is a deviation event in which there is a deviation in said pre-determined characteristic.

19. System of claim 8 wherein the process is a continuous process for the manufacture of a product.

* * * * *



US005821990A

United States Patent [19]

Rudt et al.

[11] Patent Number: **5,821,990**[45] Date of Patent: ***Oct. 13, 1998**[54] **SYSTEM FOR MONITORING A
CONTINUOUS MANUFACTURING PROCESS**

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[*] Notice: The term of this patent shall not extend
beyond the expiration date of Pat. No.
5,717,456.

[21] Appl. No.: **929,231**[22] Filed: **Sep. 3, 1997****Related U.S. Application Data**

[62] Division of Ser. No. 399,235, Mar. 6, 1995, Pat. No.
5,717,456.

[51] Int. Cl.⁶ **H04N 7/18**

[52] U.S. Cl. **348/88; 348/86; 348/125**

[58] Field of Search **348/88, 86, 125,**
348/92, 94, 128; 356/429, 430, 240; 382/141

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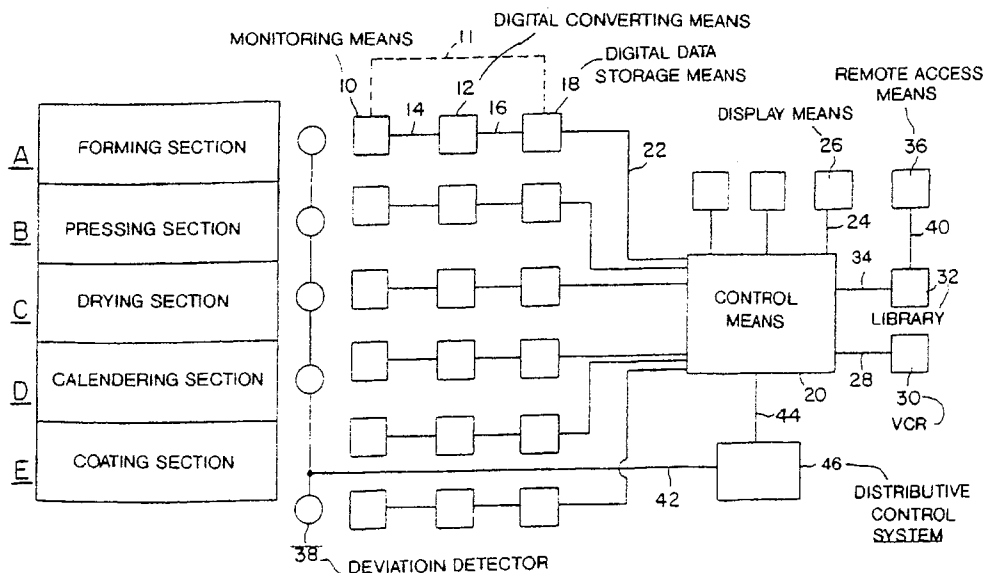
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[57] **ABSTRACT**

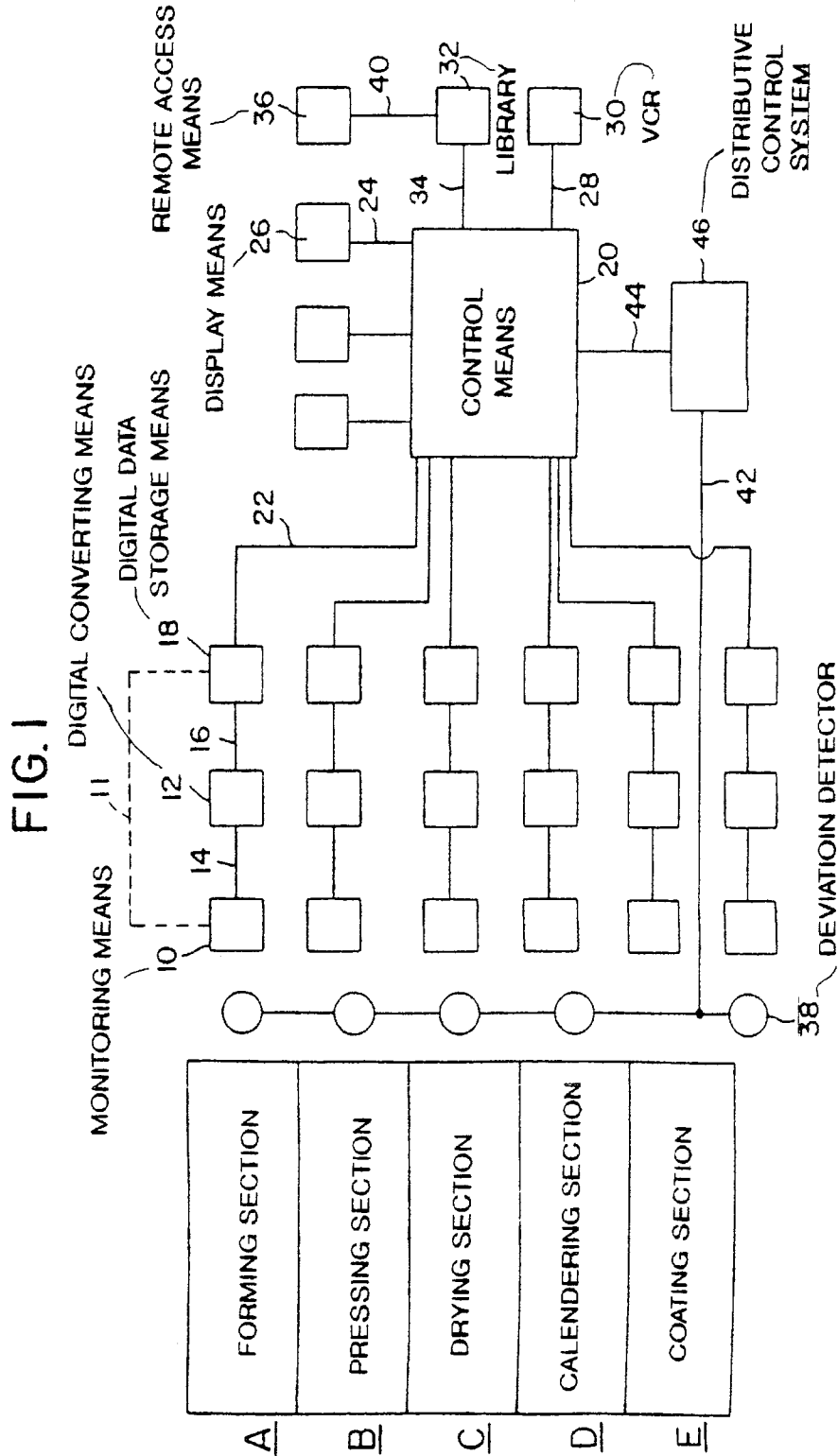
A system for continuously monitoring a process such as a paper making process wherein a plurality of video cameras are positioned at various positions along the process to monitor one or more pre-determined characteristics of the process. The system further includes device for converting the monitored characteristics into digital format and a digital data storage device, such as a circular memory, for storage of such data such that as new data is stored earlier stored data is removed. The system includes a control device such as a computer which is capable of communicating with the data storage device and with a detector for detecting deviations from the monitored predetermined characteristic such that on receipt of a deviation signal the control device extracts from the digital data storage device digitized data corresponding to the deviation and displays such extracted deviation digitized data as for example on a video monitor.

66 Claims, 1 Drawing Sheet

U.S. Patent

Oct. 13, 1998

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SYSTEM FOR MONITORING A CONTINUOUS MANUFACTURING PROCESS

This is a division of application Ser. No. 08,399,235,
filed Mar. 6, 1995 pending

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to a system for monitoring a process. More particularly, this invention relates to such a system in which process data relating to a predetermined characteristic of the process is collected and stored in digital format and extracted based upon a predetermined criterion for display.

2. Description of the Prior Art

Processes are known for the continuous production or handling of a product. Illustrative of such processes are those for the production or handling of continuous products, as for example polymeric films, paper webs, metallic webs, roll printing processes and the like. Other such processes include those for production or handling of discrete products such as sheet printing processes, packaging processes and the like.

A desired objective of these processes is that the product have certain pre-determined characteristics, as for example characteristics which insure that the product is of acceptable quality. A failure to detect and correct deviations from these pre-determined characteristics is an extreme disadvantage adversely affecting the economics of the process as for example because of lost production time, discarding of unacceptable product, and the like.

As a result, systems for inspecting and observing the product by continuous processes have been developed. See for example the systems described in U.S. Pat. Nos. 4,951,223; 4,814,869; 5,239,376; and the like. These systems usually involve the monitoring through use of one or more video cameras strategically placed along the production line, storage of video output on video tapes, means for shutting down production of the product in the event of deviations from pre-determined characteristics and playback of video tapes to determine the cause of the deviations so that corrections can be made in a timely fashion. These known monitoring systems suffer from one or more disadvantages which adversely affect their performance. For example, these prior processes are manual and require re-winding of the tape which results in down time of the system and long processing times. Moreover, tapes often degrade and it is difficult to access those portions of the tape containing relevant information or to make good copies. In these systems the tapes are not networked or tied together and the system cannot simultaneously record and played back. The system of this invention obviates one or more of these disadvantages.

SUMMARY OF THE INVENTION

This invention provides a monitoring system for continuously monitoring the operations of a machine for the continuous manufacture of a product. More particularly, the system of this invention comprises:

a plurality of monitoring means for continuously monitoring a pre-determined characteristic of the process and collecting monitored data, each monitoring means addressing a different location of interest of said process, and capable of monitoring and collecting real time data relative to said location,

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data converting means for converting said output data into digitized data;

digital data storage means capable of storing segments of said digitized data, each of said segments comprised of a plurality of digitized data clips, said segments and said clips of predetermined lengths which cover the operations of said process at a relevant location over a predetermined period of time, said digitized data segments being stored such that as new digitized data is stored in said segment, the earliest prior stored digitized data in said segment is displaced from said segment to maintain said segment at said predetermined length; and

control means for controlling said monitoring system, said control means in communication with said digital data storage means and capable of extracting one or more digitized data clips according to predetermined criterion to form one or more extracted clips, and capable of displaying said extracted clips.

As used herein, "compression" means applying data reduction means such as an appropriate algorithm, technique, technology or the like to digitalized data for a real time event at a location in a process to reduce the amount of digitized data required to recreate the event. As used herein, "process" means an action, change or function or a series of actions, changes or functions that bring about a result or end, as for example a system of operations in the production of something. As used herein, "clip" means a digitalized data series for a location of a process during a pre-determined period of time. As used herein, "digitized" or "digitization" means to convert to or to collect in a digital format as for example conversion of an analog signal of a visual image to a digital format or collection of a visual image directly into a digital format. As used herein, "digital" means information in a binary format, or zeros and ones, usual for storage in a digital data storage means such as a computer. As used herein, "segment" means a portion of the digital data storage means containing one or more digitized data clips.

In a preferred embodiment of the invention, said process is a continuous process for the manufacture of a product, and said deviation event is a deviation in a pre-determined characteristic of said product.

In a more preferred embodiment of the invention, the system comprises a plurality of storage means, each of which comprises at least one digitized data segment, at least one of said storage means capable of storing digitized data monitored and collected from first monitoring means at a first location of the process and at least one of said storage means capable of storing data monitored and collected from a second monitoring means at a second location of the process. Preferably, the control means is capable of extracting clips from segments stored in two or more of said plurality of said storage means such that said extracted clips are time synchronized to chronologically show the pre-determined characteristic of a single discrete product or a portion of a continuous product as said product passes by each location of the digitized data in said extracted clips. Alternatively, the control means is capable of extracting the event clip recording said event and the clip immediately preceding said event clip from the segment containing data from a single location of the process, and optionally the data clip immediately following the event clip, splicing said clips in chronological order to form a display clip and displaying said display clip.

In another preferred embodiment, the process comprises a plurality of steps and wherein there is at least one monitoring means, data converting means and data storage means for said step

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In still another preferred embodiment, the process is controlled by a distributive control system in communication with said control means, said control system having one or more deviation detectors for monitoring said pre-determined characteristic, each of said detectors addressing a different location of interest along the process and capable of detecting deviation events and communicating a signal of said deviation event, and the time and location of said event to said control means;

wherein on receipt of said deviation event signal said control means capable of identifying data storage means containing the digitized data segment corresponding to said deviation event, extracting the deviation event clip and displaying said display clip, and wherein said distributive control system is preferably capable of communicating process data relating to the operation of the process and the time of break to said control means.

In yet another preferred embodiment, the control means is capable of extracting the event clip recording said event and the clips immediately preceding and optionally the clip immediately following said event clip, splicing said clips into a display clip chronological order and displaying said display clip.

A most preferred embodiment of this invention relates to a monitoring system for monitoring the manufacture of a continuous web of paper having one or more pre-determined characteristics in a paper manufacturing machine comprising:

a plurality of monitoring means which comprises one or more video cameras for monitoring the paper web, each monitoring means addressing the paper web at a different location of interest along the paper manufacturing machine and capable of producing a video image of the paper web at the location;

digital converting means for converting the video image into a digitized video signal;

digital data storage means capable of receiving said digitized video signal and storing digitized segments thereof, each of which comprises a plurality of digitized clips, said digitized segments and clips of a predetermined length covering real time operation of said machine, said digitized segments being stored such that the earliest prior stored digitized data in said segment is displaced as new digitized data, is stored in said segment to maintain said stored segment at said predetermined length;

Computer control means for controlling the operations of said system, said means in communication with said digital data storage means and capable of controlling same, said computer control means in communication with a distributive control system for controlling said machine, said system having one or more deviation detectors for detecting deviations from predetermined characteristics as said paper web passes through said machine said control system capable of communicating process master time and date information to said computer control system; and

one or more video monitors in communication with said computer control means and capable of displaying the image of digitized video signals under the control of said computer control means;

wherein on occurrence of a deviation from the predetermined characteristics of said web, said distributive control system transmits a deviation signal comprising the time, date and location of said deviation event to

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said computer control means, and in response thereto said computer control means identifying the digitized data segment corresponding to said deviation event, extracting the deviation event clip, the preceding clip preceding said break event clip to form a display clip and displaying said display clip on a video monitor.

The system of this invention obviates one or more disadvantages of prior art monitoring systems. For example, There no loss or substantially no loss of data due to rewinding, no or substantially no deterioration in the stored data and good copies of the data can be made. The system can be easily used in an automatic mode and allows simultaneous observation and collection/storage of data. The system allows the monitoring of the process from a central location or from one or more other locations, and allows correlations between collected/recorded data and other process operations data.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention and the advantages attendant thereto will become apparent upon a reading of the following detailed description of the invention taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a depiction of a preferred embodiment of this invention showing a schematic of a paper making machine, including a possible configuration of surveillance cameras and web failure detection devices.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is directed to a system for monitoring a machine or process for manufacture of a product. While the preferred embodiment of FIG. 1 depicts the system in use to monitor a paper manufacturing process and machine. The nature of the process may vary provided that the process has a pre-determined characteristic. The process may be batch, semi-continuous or continuous, or automatic or manual. For example, the process may monitor people or things entering or leaving a building or a room in a building or a process for the manufacture or handling of discrete or continuous products. In the preferred embodiments of the invention, the process is for the manufacture or handling of a product. Processes for manufacturing and handling discrete products include processes for extruding, packaging, filling, bottling, sheet fed printing, conveying, converting, wrapping, stamping, or assembling a discrete product. Processes for manufacturing or handling a continuous product include those for the manufacture of a continuous web material such as a polymeric or metal sheet or film, printed paper, carpet, woven material, non-woven material, textile material or photographic film which has certain predetermined characteristics which must not be deviated from. The system can be conveniently used to monitor the manufacture of such continuous or discrete products to monitor for any deviations from the desired pre-determined characteristic(s).

The system is especially useful in paper manufacture as depicted in more detail in FIG. 1. FIG. 1 depicts a schematic representation of a paper making machine in which the wet end forming section is at the top and the final product section is at the bottom. As depicted in the figure, the machine consists of five sections, denoted by A, B, C, D and E. A denotes the forming section; B denotes the pressing section; C denotes the drying section; D denotes the calendaring section; and E denotes the coating section. As shown on FIG. 1, monitoring means 10 are strategically positioned at various locations of interest along the paper making machine.

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Observing means 10 may vary widely and depends on a pre-determined characteristic of the product being monitored for deviation events. Illustrative of useful observing means are those which employ coherent or non-coherent visual, gamma, infra-red, ultraviolet, thermal and nuclear radiation, sonics, ultrasonics, magnetic fields, pressure, odor and the like. The particular observing means 10 used in any particular situation will normally depend on the pre-determined characteristics of the product being observed and the event which indicates a deviation from the pre-determined characteristic. For example, if the pre-determined characteristic is continuity of the web of paper and the deviation is a break or hole in the web, then monitoring means which employs visual radiation such as a video camera can be conveniently employed. On the other hand, if the pre-determined characteristics are moisture content, surface texture, color, gloss and the like monitoring means which involve the use of visual and infrared radiation may be used.

In the preferred embodiment of this invention depicted in FIG. 1, monitoring means is a plurality of video cameras 10. While seven cameras 10 are depicted in the figure, the number of cameras employed may vary widely, and any number capable of providing the desired degree of monitoring can be employed. The positioning of various monitoring means 10 may vary widely depending on the needs of the user. In the preferred embodiment depicted in FIG. 1, where the pre-determined characteristic of the web being monitored is web continuity and deviations in this characteristic being detected are break events, hole events or a combination thereof, the number of cameras 10 and camera positions are such that locations where breaks are most likely to occur are covered. For example, as depicted in FIG. 1, cameras 10 are positioned at the drawing section, coating section, size pressing section, center rolls section, sheet pick-up section and reeling device section.

The system of this invention also includes digital converting means 12 means for converting data obtained or generated by monitoring means 10 into a digital format. Digital converting means employed may vary widely and any such means capable of performing this function may be used. Illustrative of suitable digital converting means 12 are electronic circuit boards, converting signal processors, video boards, micro-chips, and assorted software. The number of digital converting means 12 and the relationship of digital converting means 10 to monitoring means 10 may vary widely, the only requirement is that relevant monitored data is eventually converted into digital format. For example, there may be a single digital converting means 12 for each monitoring means 10 or there may be one or more digital converting means 12 for all monitoring means 10 or various other combinations of converting means 12 and monitoring means 10 may be employed. Digital converting means 12 and monitoring means 10 may be separate devices as depicted in FIG. 1, or these functions may be performed by the same device as for example a digital video camera 10 which directly monitored data in a digital format, which data is conveyed directly to digital data storage means 18 via conductor 11.

As depicted in FIG. 1, each video camera 10 monitors the web and monitored data is generated in an analog format. The analog data is then conveyed to digital converting means 12 via conductor 14 where the analog data is converted to digital format by digital converting means 12, with or without data compression. The digitized data is then conveyed via conductor 16 to digital data storage means 18.

The specific digital data storage means 18 may vary widely provided that such means allows storage of segments

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of digitized data having a pre-determined length which covers data obtained by monitoring means 10 which cover the real time operations of the machine over a predetermined period of time. The segment, in turn, is comprised of a plurality of digitized data clips which are also of a pre-determined length which also cover the real time operations of the machine over a predetermined period of time. The segments and clips are in chronological order and are preferably identified by date and time at which the data was collected which greatly facilitates access to relevant data clips on occurrence of a deviation event. Preferably, the clips are also stored such that clips can be readily identified by time and date, and can be extracted or copied from the segment. A further requirement of the digital memory storage means 18 is that it can be controlled by a control means 20 such that specific clips can be extracted from the digital data storage means 18 as desired and as will be described hereinbelow in more detail. In the operations of the digital data storage means 18, the segment is maintained at or about the pre-determined length during the operations of the system such that as new digitized real time data is added to digital data storage means 18, the oldest or most prior data is erased, deleted or otherwise removed from storage means 18 maintaining said segment at or about some pre-determined length. The advantages of this storage means 10 becomes readily apparent in that stored digital data showing normal operations to produce the product having the pre-determined characteristic is constantly removed from storage means 18 such that upon storage of deviating digitized data of a deviation from the pre-determined characteristic, as for example a break event, such deviating data can be more easily isolated from the relatively small amount of data comprising the segment.

The pre-determined length of the segment and the clips may vary widely initially and during the operation of the system, usually depending upon function and capacity of the digital data storage means, duration of the deviation event and the like. The length of the segments are preferably less than about 60 minutes, more preferably from about 15 to about 60 minutes, and most preferably from about 15 to about 30 minutes. The length of the clips comprising a segment is preferably less than about 60 secs., more preferably from about 5 to about 60 secs., more preferably from about 5 to about 20 to 30 secs and most preferably from about 5 to about 10 secs.

The digitized data storage means 18 utilized in any particular situation may vary widely. Illustrative of useful data storage means 18 are hard drive, tape, diskette, CD rom, magnetic optical drive, solid state memory, flash memory, optical device, and the like. Preferred digitized data storage means 18 are hard drives and CD roms. As depicted in FIG. 1, the most preferred digitized data storage means 18 is a hard drive and is in communication with control means 20 by way of connector 22. Control means 20 functions to control the system. Useful control means 20 may vary widely, the only requirement is that means 20 is in the event of a deviation event able to locate the data clip containing data of such event, to extract such data clip and to display said data clip. Illustrative of useful control means 20 are analog control system and a digital computer.

As depicted in FIG. 1, control means 20 is a digital computer which communicates via connector 24 to a plurality of display means 26 which in the embodiment of FIG. 1 are video monitors. Useful display means 26 may vary widely the only is that such means is capable of displaying data to the satisfaction of the operator. Other useful display means 26 are printers, projection systems, photographic

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imagers and the like. Also connected to control means 20 by way of cable 28 is a video recorder 30 as for example a VCR for recording for wider distribution of data and a library 32 for storage of data by way of cable 34. As depicted in the figure, library 32 can be accessed from various locations by remote access means 36 such as a local area network, wide area network, e-mail services, satellite, compact disk and the like connected to library 32 via cable 40.

FIG. 1 also depicts a plurality of deviation detectors 38 strategic positioned along the machine in a well known manner to detect deviations in the pre-determined characteristics in the product being monitored. Detectors 38 are connected to the machine control or distributive control system 46 via cable 42 for transmission of a deviation signal to system 46. System 46 also communicates with control 20 via cable 44 such that various information can be transmitted to control 20 from system 46 in the event of a deviation from the pre-determined characteristic as for example a break in a web. Such information includes the detection of a deviation event, time of detection of the deviation event and such other process data relating to the operations of the machine at the time of deviation event deemed appropriate.

In operation, monitoring means 10 continuously monitors a pre-determined characteristic of the product being produced by the machine. The monitored data is conveyed via cable 14 to digital conversion means 12 where the data is converted to a digital format, and the digitized data is conveyed to digital data storage means 18 via cable 16 for storage. In those embodiments of the invention where the monitored data is collected in digital format by monitoring means 10, as for example by a digital video camera, the digitized data is converted directly to digital data storage means 18 via cable 11. During operations where there are no deviations from the pre-determined characteristics, digitized data flows continuously into storage means 18 such that only a pre-determined amount of data converting a pre-determined period of time during the operation of the machine is always maintained in storage and that as new data is stored the oldest or most prior data is deleted or erased.

If a deviation in the pre-determined characteristics of the product occurs, it is detected by a deviation detector 38. Detector 38 sends a deviation signal to distributive control system 46 via cable 42, and the signal is relayed to control means 20 via cable 44. In addition to a deviation signal, detector 38 may also inform control system 46 of the identity of detector 38 detecting the deviation event, the time of the deviation event and location in the process of the deviation event. This information together with other process data such as type of product being manufactured, machine operation parameters, machine speed, draw ratios, furnish, types, additives, coating components, calendaring pressures, coating thickness, basis weight of the paper and the like are conveyed to control means 20. On receipt of the deviation event signal, control means 20 is capable of identifying the clip most likely to have digitized data relating to the deviation event, and extracting such clip and displaying the extracted clip with display means 26. For example, control means 20 can perform this function by coordinating the time at which deviation event detector 38 detected the deviation event with the clip or clips corresponding in time. This coordination can be done in any suitable manner. For example, control 20 can scan all digitized data storage means 18, select clips from all means 18 containing data collected at the appropriate time and can then scan each clip to identify the deviation event and display same. Alternatively, control means 20 can identify the monitoring

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means 10 most proximate to the location of the deviation event, select a clip or clips from the digitized data storage means 18 for such monitoring means 10 and display such clip. In order to insure that all suitable data is displayed in the fastest possible time, preferably control means 20 will also extract digitized data clips immediately preceding and following the clip or clips most likely containing data for the deviation event and will splice the deviation event clip and the following and preceding clips into a display clip for display. By splicing the event, preceding and following clips, the operation of the machine prior to, during and subsequent to the deviation event can be observed. After a deviation is detected, the machine is usually stopped and the digitized data storage means 18 is frozen to prevent loss of critical data.

The clips can be displayed automatically or manually at any suitable speed. The clips can be displayed frame by frame, in various sizes. The clips can also be viewed in reversed mode. This function combined with a pause, play-back and resizing can enhance the ability of the operators to locate the exact point of interest on the display clip, for study showing the deviation event as it occurred. Of course, many other functions may be provided by control means 20 including zooming, edge enhancement, image sharpening, gradient edge enhancement, de-specking, filtering, cropping, desizing, dithering, interpolation, image intensity, format conversion, color inversion, contrast control, brightness control, embossing and the like. Manual/automatic control of all functions may be provided.

In this manner, the control means 20 becomes the driver which also manages the logistics of the system including monitoring, displaying, storage, etc., and can additionally be used to supervise the status of each device in the system as desired. In addition, other peripherals can be provided as needed.

The ability to review the critical period just prior to the deviation event at any desired speed provides the input necessary to evaluate the cause of the problem so that necessary adjustments and/or repairs can be started quickly and the machine restored to normal operation. If only a defect in the product is to blame, this, too, often will show up. In this manner, valuable time can be saved.

The clip or clips covering the deviation event are displayed, the cause of the deviation event can be discovered and appropriate action can be taken to correct the cause of the event. The process or machine and the monitoring system can then be reactivated.

The clips relating to the deviation event together with any other process data associated with the deviation event are conveyed via line 34 to library 32 for storage. In this manner, a collection of deviation clips and associated process data is formed which can be accessed by remote access 36 via connector 40 for suitable purposes as for example for accessing, and correlating or otherwise evaluating accessed data based on or more variables such as process times, properties, products, types or modes of deviation events, recorded observations, types of machines, and like process or product characteristics, and to document machine or process defects such as a hole in the felt or wire. The clips and associated process data may also be conveyed via connector 28 to video recorder 30 for storage on a video tape.

This invention has been described in this application in considerable detail in order to comply with the Patent Statutes and to provide those skilled in the art with the information needed to apply the novel principles and to

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construct and use such specialized components as are required. However, it is to be further understood that the invention can be carried out by specifically different equipment and devices and that various modifications both as to equipment and procedure details can be accomplished without departing from the scope of the invention.

What is claimed is:

1. A monitoring system for continuously monitoring a process comprising:

a plurality of monitoring means for continuously monitoring a predetermined characteristic of the process and collecting monitored data, each monitoring means addressing a different location of interest of said process, and each said monitoring means for monitoring and collecting data relative to said location;

data converting means for converting said collected data into digitized data;

digital data storage means for storing segments of said digitized data, each of said segments comprised of one or more digitized data clips, said segments which cover the operations of said process over a predetermined period of time, said digitized data segments being stored such that as new digitized data is stored in one of said segments, earlier prior stored digitized data in said segment is removed from said segment to maintain said segment at or about said pre-determined length; and

control means for controlling said monitoring system, said control means for communicating with said digital data storage means and for communicating with one or more deviation detectors for detecting a deviation from said predetermined characteristic and for transmitting a deviation signal of said detected deviation to said control means, wherein on receipt of said deviation signal said control means for extracting a deviation clip from said segments stored in said digital data storage means and means for displaying said extracted clip.

2. System of claim 1 wherein said process is a continuous process for the manufacture of a product, and said deviation is a deviation in a pre-determined characteristic of said product.

3. System of claim 2 wherein said process comprises a plurality of monitoring steps and wherein there is at least one monitoring means for each of said steps.

4. System of claim 1 which comprises a plurality of storage means, each of which comprises at least one of said digitized data segment, at least one of said storage means for storing digitized data monitored and collected from first monitoring means at a first location of the process and at least one of said storage means for storing data monitored and collected from a second monitoring means at a second location of the process.

5. System of claim 4 wherein each of said plurality of storage means stores digitized data monitored and collected by a single monitoring means.

6. System of claim 1 wherein a plurality of monitoring means address a single location, each in communication with a digital data converting means which is in communication with a digital data storage means, said control means for extracting one or more digitized data clips from each of said storage means and for displaying said extracted clips.

7. A system of claim 6 wherein each of said monitoring means monitors a different pre-determined characteristic.

8. A system of claim 7 wherein each of said monitoring means is different.

9. System of claim 1 wherein said process is controlled totally or in part by a distributive control system in com-

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munication with said control means, said distributive control system comprising said one or more deviation detectors, said distributive control system for communicating a signal of said detected deviation and the time, location or time and location of said deviation to said control means;

wherein on receipt of said deviation signal said control means for identifying the stored segment containing a digitized data clip corresponding to said deviation, extracting the deviation clip to form a display clip and displaying said display clip.

10. System of claim 9 wherein said distributive control system is also for communicating process data relating to the operation of the process to said control means.

11. System of claim 10 which further comprises:

library means in communication with said control means for storage of display clips and process data relating to the operation of the process at the time of said deviation, said library means also for providing said stored display clips and process data for display.

12. System of claim 1 wherein on receipt of said deviation signal said control means is for extracting the deviation clip recording said deviation and one or more preceding clips preceding said deviation clip in time or time and location, such that said extracted clips are time synchronized to chronologically show the predetermined characteristics as said product passes by each monitored location of the digitized data in said extracted clips, said control means for splicing said extracted clips in chronological order to form a display clip and displaying said display clip.

13. System of claim 12 wherein said control means for extracting the deviation clip recording said deviation, the clip immediately preceding said deviation clip in time or in time and location, the clip immediately following said deviation clip in time or time and location, splicing said extracted clips in chronological order to form a display clip and displaying said display clip.

14. System of claim 1 wherein said monitoring means are video cameras and wherein at least one digital converting means is in communication with at least one video camera and at least one digital data storage means is in communication with at least one digital converting means.

15. System of claim 14 wherein on receipt of said deviation signal at the time of said deviation, said control means identifies a video camera proximate to said deviation detector detecting said deviation, freezes operations of digital memory storage means for such camera, identifies the digitized data segment corresponding to said deviation by correlating the time of said segment with the time of said deviation event, extracting the deviation event clip which correlates to the time of said deviation event and the preceding clip preceding said deviation event clip and the subsequent clip following said deviation event clip, splicing said deviation event clip, said preceding clip and said subsequent in chronological order to form a display clip and displaying said display clip on said display means.

16. System of claim 15 which further comprises:

means for transmitting process data from a distributive control system with a break event signal;

library means for storage of display clips and associated process data; and

means for accessing said display clips and process data stored in said library means.

17. System of claim 1 wherein said process is a continuous product and said deviation is selected from the group consisting of a break in said continuous product, a hole in said continuous product and a change in a surface characteristic of said continuous product.

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18. System of claim 1 wherein each of said monitoring means and said data converting means are combined in a digital camera.

19. System for claim 1 wherein said control means is a computer.

20. System of claim 1 wherein:

a product of said process is a continuous web of paper and said process is for printing or manufacturing said web of paper;

said plurality of monitoring means comprises one or more cameras for monitoring said web of paper, each monitoring means for addressing said product at a different location of interest along said process and for producing an image of said product at the location of interest;

digital converting means for converting the image into a digitized image;

digital data storage means for receiving said digitized image and storing said digitized image in a digitized segment comprising one or more digitized images, said digitized segment of a predetermined length covering real time operation of said process, said digitized images being stored such that earlier prior stored digitized images in said digitized segment are displaced as new digitized images are stored in said digitized segment to maintain said stored digitized segment at or about said predetermined length;

computer control means for controlling the operations of said system, said computer control means for communicating with said digital data storage means and for communicating with a distributive control system for controlling all or a portion of said process, said distributive control system having said one or more deviation detectors for detecting deviations from predetermined characteristics of said product as said product passes through said process, said distributive control system for communicating to said computer control system information comprising the time, location or time and location of said deviations, information relative to said operations of said process or a combination thereof; and

one or more monitors in communication with said computer control means for displaying said digitized images under the control of said computer control means;

wherein on occurrence of said deviation said distributive control system transmits said deviation signal comprising the location or time, and location of said deviation to said computer control means, and in response thereto said computer control means identifies said digitized segment or said digitized image corresponding to said deviation or a combination thereof, extracts said digitized image comprising said deviation and displays said extracted digitized image on a monitor.

21. System of claim 20 wherein each of said monitoring means and digital converting means are combined in a digital camera.

22. System of claim 1 wherein each of said monitoring means and one or more of said detectors are combined in a camera.

23. System of claim 1 wherein said deviation signal comprises the time, location or time and location of said detected deviation.

24. System of claim 23 wherein said deviation signal comprises the location of said detected deviation.

25. A monitoring system for continuously monitoring a process comprising:

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a plurality of monitoring means for continuously monitoring a pre-determined characteristic of the process and collecting monitored data, each monitoring means addressing a different location of interest of said process, and each said monitoring means for monitoring and collecting data relative to said location;

digital converting means for converting said collected data into digitized data;

digital data storage means for storing segments of said digitized data, said segments of which cover the operations of said process at a relevant location over a pre-determined period of time, said digitized data segments being stored such that as new digitized data is stored in a segment, earlier prior stored digitized data in said segment is removed from said segment to maintain said segment at or about a pre-determined length; and

control means for controlling said monitoring system, said control means for communicating with said digital data storage means and for communicating with one or more deviation detectors for detecting a deviation from said predetermined characteristic and for transmitting a deviation signal of said detected deviation to said control means; wherein on receipt of said deviation signal said control means for extracting from said digital data storage means deviation digitized data corresponding to said detected deviation to form extracted digitized data and said control means for displaying said extracted digitized data.

26. System of claim 25 wherein said system further comprises a monitor and wherein said extracted digitized data is displayed visually on said monitor.

27. System of claim 25 wherein on receipt of said deviation signal said control means for extracting the deviation digitized data and preceding digitized data preceding said digitized data in time or time and location such that said extracted preceding and deviation digitized data are time synchronized to chronologically show the monitored predetermined characteristics as said process passes by each monitored location of the digitized data in said extracted clips, and said control means for controlling said means for displaying said extracted clips.

28. System of claim 27 wherein said control means for extracting the deviation digitized data, the preceding digitized data, and the digitized data immediately following extracting said deviation digitized data in time or time and location and said control means for controlling said means for displaying said extracted digitized data.

29. System of claim 25 wherein said data converting means and each of said monitoring means are combined in a digital camera.

30. System of claim 25 wherein said monitoring means is a video camera.

31. System of claim 25 wherein said pre-determined characteristic is a characteristic of said process.

32. System of claim 25 wherein said control means is a computer.

33. System of claim 25 wherein:

a product of said process is a continuous web of paper and said process is a process for printing or manufacturing said web of paper;

said plurality of monitoring means comprises one or more cameras, each camera addressing said product at a different location of interest along said process and producing an image of said product at said location of interest;

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digital converting means for converting the image into a digitized image;

digital data storage means for receiving said digitized image and storing said digitized image in a digitized data segment comprising one or more digitized images, said digitized data segment of a pre-determined length covering real time operation of said process, said digitized images being stored such that earlier prior stored digitized images in said digitized segment are displaced as new digitized images are stored in said digitized segment to maintain said stored digitized segment at or about said predetermined length;

computer control means for controlling the operations of said system, said computer control means for communicating with said digital data storage means and for communicating with a distributive control system for controlling all or a portion of said process, said distributive control system having said one or more deviation detectors for detecting deviations from predetermined characteristics of said product as said product passes through said process, said distributive control system for communicating to said computer control system information comprising the location or time and location of said deviations; information relative to the operations of said process or a combination thereof, and

one or more monitors in communication with said computer control means for displaying the digitized images under the control of said computer control means;

wherein on occurrence of said deviation, said distributive control system transmits said deviation signal comprising the location or time and location of said deviation to said computer control means, and in response thereto said computer control means identifies said digitized segment or said digitized image corresponding to said deviation or a combination thereof, extracts said digitized image comprising said deviation and displays said digitized image on said monitor.

34. System of claim 33 wherein each of said monitoring means and digital converting means are combined in a digital camera.

35. System of claim 25 wherein each of said monitoring means and one or more of said detectors are combined in a camera.

36. System of claim 25 wherein said deviation signal comprises the time, location or time and location of said detected deviation.

37. System of claim 36 wherein said deviation signal comprises the location of said detected deviation.

38. A monitoring system for continuously monitoring a process for manufacturing a product comprising:

a plurality of monitoring means for continuously monitoring a pre-determined characteristic of the process and collecting monitored data, and each said monitoring means for monitoring and collecting data relative to said process;

data converting means for converting said collected data into digitized data;

digital data storage means for storing segments of said digitized data, said segments which cover the operations of said process over a predetermined period of time, said digitized data segments being stored such that as new digitized data is stored in a segment, earlier prior stored digitized data in said segment is removed from said segment to maintain said segment at or about a pre-determined length.

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one or more deviation detectors for monitoring said pre-determined characteristic, and for detecting a deviation therefrom; and

control means for controlling each of said monitoring means, said control means in communication with said digital data storage means and with said deviation detectors, wherein on receipt of a deviation signal said control means for extracting deviation digitized data corresponding to said detected deviation from said digital data storage means to form extracted deviation digitized data and said control means for controlling the display said extracted deviation digitized data.

39. System of claim 38 wherein said monitoring means is a camera.

40. System of claim 38 wherein each of said monitoring means and said data converting means are combined in a digital camera.

41. System of claim 38 wherein each of said monitoring means and said one or more detectors are combined in a camera.

42. System of claim 38 wherein said control means is one or more computers.

43. System of claim 38 wherein said deviation signal comprises the time, location or time and location of said detected deviation.

44. System of claim 43 wherein said deviation signal comprises the location of said detected deviation.

45. A monitoring system for continuously monitoring a process for manufacture of a product comprising:

a plurality of monitoring means for continuously monitoring a pre-determined characteristic of the process and collecting monitored data, each monitoring means addressing a different location of interest of said process, and each said monitoring means for monitoring and collecting data relative to said location;

digital converting means for converting said collected data into digitized data;

digital data storage means for storing segments of said digitized data, said segments which cover the operations of said process at a relevant location over a pre-determined period of time, said digitized data segments being stored such that as new digitized data is stored in a segment, earlier prior stored digitized data in said segment is removed from said segment to maintain said segment at or about a pre-determined length;

one or more deviation detectors for monitoring said pre-determined characteristics and for detecting a deviation therefrom; and

control means for controlling each of said monitoring means, said control means in communication with said digital data storage means and with said deviation detectors, wherein on receipt of a deviation signal said control means for identifying a deviation digitized data corresponding to said deviation and extracting said identified deviation digitized data from said stored segments of digitized data in said digital data storage means to form extracted deviation digitized data, and said control means for controlling the display said extracted deviation digitized data.

46. System of claim 45 wherein said monitoring means is a camera.

47. System of claim 45 wherein each of said monitoring means and said data converting means are combined in a digital camera.

48. System of claim 45 wherein each of said monitoring means and said one or more detectors are combined in a camera.

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49. System of claim 45 wherein each of said control means is one or more computers.

50. System of claim 45 wherein said deviation signal comprises the time, location or time and location of said detected deviation.

51. System of claim 50 wherein said deviation signal comprises the location of said detected deviation.

52. A monitoring system for continuously monitoring a process for the manufacture of a product comprising a continuous web of paper, said system comprising:

a plurality of monitoring means comprising a plurality of video cameras for monitoring a predetermined characteristic of the process and collecting monitored data, said cameras addressing locations of interest of said process and said cameras for producing video images relative to said locations;

digital data converting means for converting said video images into digitized video signals;

digital data storage means for receiving said digitized video signals and for storing segments of said digitized video signals, said segments which cover the operations of said process over a predetermined period of time, said digitized video signals being stored such that as new digitized video signals are stored in a segment, earlier prior stored digitized video signals in said segment are removed from said segment to maintain said segment at or about a pre-determined length; and

control means for controlling each of said monitoring means, said control means comprising one or more computers, said control means for communicating with said digital data storage means and for communicating with one or more deviation detectors for detecting a deviation from said predetermined characteristics and for transmitting a deviation signal of said detected deviation to said control means, wherein on receipt of said deviation signal said control means for extracting a deviation digitized video signal from said segments stored in said digital data storage means and for controlling the display of said extracted deviation digitized video signal or an image thereof.

53. System of claim 52 wherein said system further comprises one or more video monitors for displaying said

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image of said extracted deviation digitized video signal and said control means for controlling the display of an image of said extracted deviation digitized video signal on one or more of said one or more video monitors.

54. System of claim 52 wherein said system further comprises one or more deviation detectors for monitoring said predetermined characteristics and for detecting deviations therefrom.

55. System of claim 54 wherein said monitoring means and said one or more detectors are combined in said video cameras.

56. System of claim 52 wherein said process is for printing said web of paper.

57. System of claim 52 wherein said process is for manufacturing said web of paper.

58. System of claim 57 wherein each predetermined characteristic is a characteristic of said product.

59. System of claim 58 wherein said predetermined characteristic is a continuity of said web.

60. System of claim 59 wherein said deviation is a break or hole in said web.

61. System of claim 60 wherein said deviation detectors further comprises one or more deviation detectors for monitoring said predetermined characteristics and for detecting deviations therefrom.

62. System of claims 61 wherein each of said monitoring means and said deviation detectors are combined in said video camera.

63. System of claim 61 wherein said deviation signal comprises the time, location or time and location of said detected deviation.

64. System of claim 52 wherein said predetermined characteristic is a characteristic of said product.

65. System of claim 52 wherein each of said monitoring means and said data converting means are combined in a digital camera.

66. System of claim 52 wherein said deviation signal comprises the time, location or time and location of said detected deviation.

* * * * *



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(54) **SYSTEM FOR MONITORING A
CONTINUOUS MANUFACTURING PROCESS**

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1997, now Pat. No. 5,821,990.

(51) Int. Cl.⁷ **H04N 7/18**

(52) U.S. Cl. **348/88; 348/86; 348/125**

(58) Field of Search **348/86, 88, 92,**
348/94, 125, 128; 356/429-430, 240; 382/141

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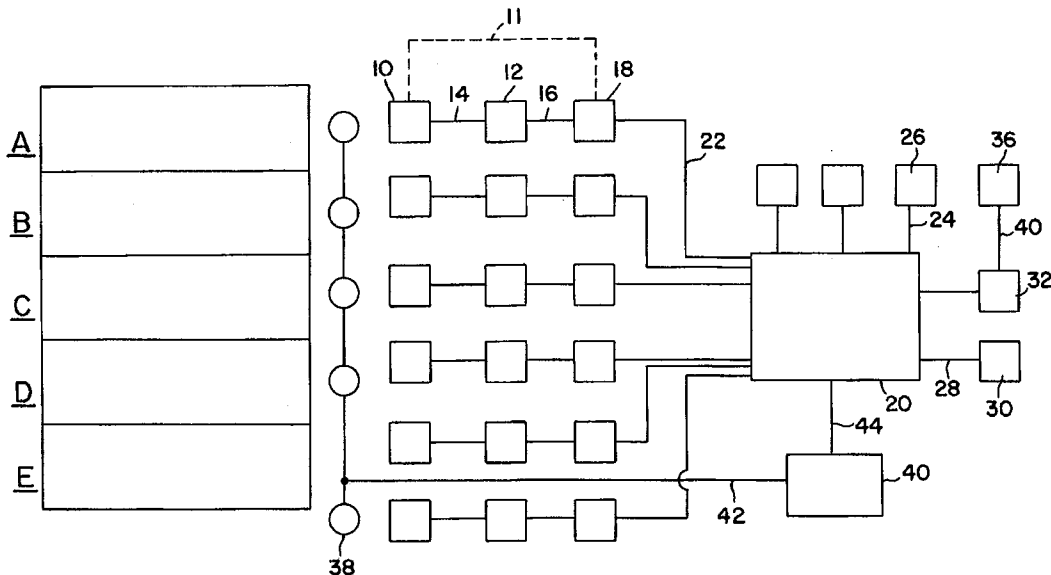
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(57) **ABSTRACT**

This invention relates to a system for monitoring a process which includes a plurality of monitoring means such as video camera which collects data relative to the process. The collected data is converted into a digital format and the digitized data stored in digital data storage device such that as new data is stored earlier stored data is removed to maintain about the same volume of stored data. The system also includes a control such as a computer which communicates with the digital data storage device. In the event of a deviation from a process parameter, the control is adapted to extract and display the digitized data corresponding to the deviation.

47 Claims, 1 Drawing Sheet

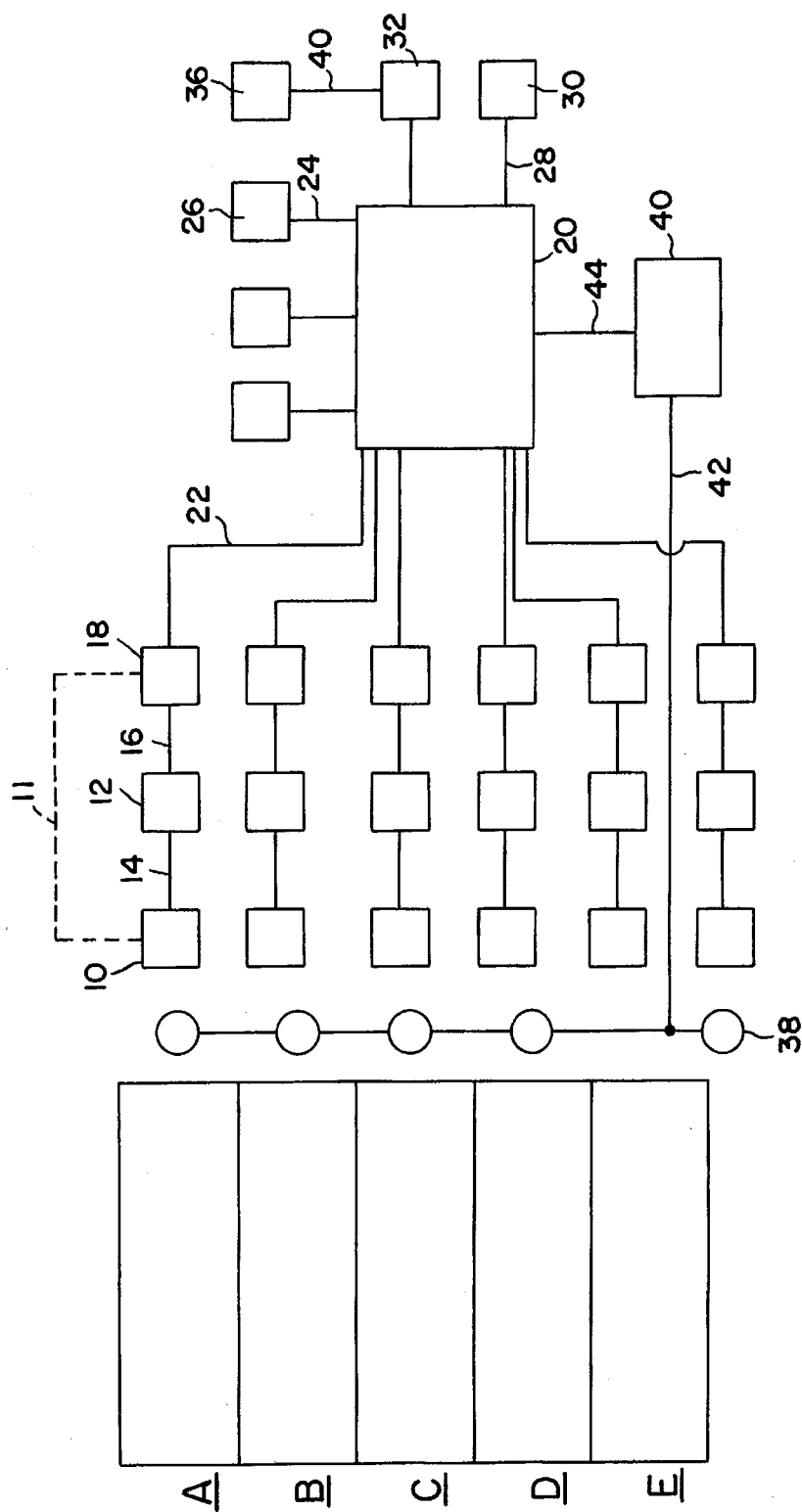


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FIG. 1



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SYSTEM FOR MONITORING A CONTINUOUS MANUFACTURING PROCESS

This application is a division of Ser. No. 08/929,231,
filed Sep. 3, 1997, now U.S. Pat. No. 5,821,990.

BACKGROUND OF THE INVENTION

I. Field of the Invention

This invention relates generally to a system for monitoring a process. More particularly, this invention relates to such a system in which process data relating to a predetermined characteristic of the process is collected and stored in digital format and extracted based upon a pre-determined criterion for display.

II. Description of the Prior Art

Processes are known for the continuous production or handling of a product. Illustrative of such processes are those for the production or handling of continuous products, as for example polymeric films, paper webs, metallic webs, roll printing processes and the like. Other such processes include those for production or handling of discrete products such as sheet printing processes, packaging processes and the like.

A desired objective of these processes is that the product have certain pre-determined characteristics, as for example characteristics which insure that the product is of acceptable quality. A failure to detect and correct deviations from these pre-determined characteristics is an extreme disadvantage adversely affecting the economics of the process as for example because of lost production time, discarding of unacceptable product, and the like.

As a result, systems for inspecting and observing the product by continuous processes have been developed. See for example the systems described in U.S. Pat. Nos. 4,951,223; 4,814,869; 5,239,376; and the like. These systems usually involve the monitoring through use of one or more video cameras strategically placed along the production line, storage of video output on video tapes, means for shutting down production of the product in the event of deviations from pre-determined characteristics and playback of video tapes to determine the cause of the deviations so that corrections can be made in a timely fashion. These known monitoring systems suffer from one or more disadvantages which adversely affect their performance. For example, these prior processes are manual and require re-winding of the tape which results in down time of the system and long processing times. Moreover, tapes often degrade and it is difficult to access those portions of the tape containing relevant information or to make good copies. In these systems the tapes are not networked or tied together and the system cannot simultaneously recorded and played back. The system of this invention obviates one or more of these disadvantages.

SUMMARY OF THE INVENTION

This invention provides a monitoring system for continuously monitoring the operations of a machine for the continuous manufacture of a product. More particularly, the system of this invention comprises:

a plurality of monitoring means for continuously monitoring a pre-determined characteristic of the process and collecting monitored data, each monitoring means addressing a different location of interest of said process, and capable of monitoring and collecting real time data relative to said location;

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data converting means for converting said output data into digitized data;

digital data storage means capable of storing segments of said digitized data, each of said segments comprised of a plurality of digitized data clips, said segments and said clips of predetermined lengths which cover the operations of said process at a relevant location over a predetermined period of time, said digitized data segments being stored such that as new digitized data is stored in said segment, the earliest prior stored digitized data in said segment is displaced from said segment to maintain said segment at said predetermined length; and

control means for controlling said monitoring system, said control means in communication with said digital data storage means and capable of extracting one or more digitized data clips according to predetermined criterion to form one or more extracted clips, and capable of displaying said extracted clips.

As used herein, "compression" means applying data reduction means such as an appropriate algorithm, technique, technology or the like to digitalized data for a real time event at a location in a process to reduce the amount of digitized data required to recreate the event. As used herein, "process" means an action, change or function or a series of actions, changes or functions that bring about a result or end, as for example a system of operations in the production of something. As used herein, "clip" means a digitalized data series for a location of a process during a pre-determined period of time. As used herein, "digitized" or "digitization" means to convert to or to collect in a digital format as for example conversion of an analog signal of a visual image to a digital format or collection of a visual image directly into a digital format. As used herein, "digital" means information in a binary format, or zeros and ones, usual for storage in a digital data storage means such as a computer. As used herein, "segment" means a portion of the digital data storage means containing one or more digitized data clips.

In a preferred embodiment of the invention, said process is a continuous process for the manufacture of a product, and said deviation event is a deviation in a pre-determined characteristic of said product.

In a more preferred embodiment of the invention, the system comprises a plurality of storage means, each of which comprises at least one digitized data segment, at least one of said storage means capable of storing digitized data monitored and collected from first monitoring means at a first location of the process and at least one of said storage means capable of storing data monitored and collected from a second monitoring means at a second location of the process. Preferably, the control means is capable of extracting clips from segments stored in two or more of said plurality of said storage means such that said extracted clips are time synchronized to chronologically show the pre-determined characteristic of a single discrete product or a portion of a continuous product as said product passes by each location of the digitized data in said extracted clips. Alternatively, the control means is capable of extracting the event clip recording said event and the clip immediately preceding said event clip from the segment containing data from a single location of the process, and optionally the data clip immediately following the event clip, splicing said clips in chronological order to form a display clip and displaying said display clip.

In another preferred embodiment, the process comprises a plurality of steps and wherein there is at least one monitoring means, data converting means and data storage means for said step.

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In still another preferred embodiment, the process is controlled by a distributive control system in communication with said control means, said control system having one or more deviation detectors for monitoring said predetermined characteristic, each of said detectors addressing a different location of interest along the process and capable of detecting deviation events and communicating a signal of said deviation event, and the time and location of said event to said control means;

wherein on receipt of said deviation event signal said control means capable of identifying data storage means containing the digitized data segment corresponding to said deviation event, extracting the deviation event clip and displaying said display clip, and wherein said distributive control system is preferably capable of communicating process data relating to the operation of the process and the time of break to said control means.

In yet another preferred embodiment, the control means is capable of extracting the event clip recording said event and the clips immediately preceding and optionally the clip immediately following said event clip, splicing said clips into a display clip chronological order and displaying said display clip.

A most preferred embodiment of this invention relates to a monitoring system for monitoring the manufacture of a continuous web of paper having one or more pre-determined characteristics in a paper manufacturing machine comprising:

a plurality of monitoring means which comprises one or more video cameras for monitoring the paper web, each monitoring means addressing the paper web at a different location of interest along the paper manufacturing machine and capable of producing a video image of the paper web at the location;

digital converting means for converting the video image into a digitized video signal;

digital data storage means capable of receiving said digitized video signal and storing digitized segments thereof, each of which comprises a plurality of digitized clips, said digitized segments and clips of a predetermined length covering real time operation of said machine, said digitized segments being stored such that the earliest prior stored digitized data in said segment is displaced as new digitized data, is stored in said segment to maintain said stored segment at said predetermined length;

Computer control means for controlling the operations of said system, said means in communication with said digital data storage means and capable of controlling same, said computer control means in communication with a distributive control system for controlling said machine, said system having one or more deviation detectors for detecting deviations from predetermined characteristics as said paper web passes through said machine said control system capable of communication process master time and date information to said computer control system; and

one or more video monitors in communication with said computer control means and capable of displaying the image of digitized video signals under the control of said computer control means;

wherein on occurrence of a deviation from the predetermined characteristics of said web, said distributive control system transmits a deviation signal comprising the time, date and location of said deviation event to

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said computer control means, and in response thereto said computer control means identifying the digitized data segment corresponding to said deviation event, extracting the deviation event clip, the preceding clip preceding said break event clip to form a display clip and displaying said display clip on a video monitor.

The system of this invention obviates one or more disadvantages of prior art monitoring systems. For example, There no loss or substantially no loss of data due to rewinding, no or substantially no deterioration in the stored data and good copies of the data can be made. The system can be easily used in an automatic mode an allows simultaneous observation and collection/storage of data. The system allows the monitoring of the process from a central location or from one or more other locations, and allows correlations between collected/recorded data and other process operations data.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention and the advantages attendant thereto will become apparent upon a reading of the following detailed description of the invention taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a depiction of a preferred embodiment of this invention showing a schematic of a paper making machine, including a possible configuration of surveillance cameras and web failure detection devices.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is directed to a system for monitoring a machine or process for manufacture of a product. While the preferred embodiment of FIG. 1 depicts the system in use to monitor a paper manufacturing process and machine. The nature of the process may vary provided that the process has a pre-determined characteristic. The process may be batch, semi-continuous or continuous, or automatic or manual. For example, the process may monitor people or things entering or leaving a building or a room in a building or a process for the manufacture or handling of discrete or continuous products. In the preferred embodiments of the invention, the process is for the manufacture or handling of a product. Processes for manufacturing and handling discrete products include processes for extruding, packaging, filing, bottling, sheet fed printing, conveying, converting, wrapping, stamping, or assembling a discrete product. Process for manufacturing or handling a continuous product include those for the manufacture of a continuous web material such as a polymeric or metal sheet or film, printed paper, carpet, woven material, non-woven material, textile material or photographic film which has certain predetermined characteristics which must not be deviated from. The system can be conveniently used to monitor the manufacture of such continuous or discrete products to monitor for any deviations from the desired pre-determined characteristic(s).

The system is especially useful in paper manufacture as depicted in more detail in FIG. 1. FIG. 1 depicts a schematic representation of a paper making machine in which the wet end forming section is at the top and the final product section is at the bottom. As depicted in the FIGURE, the machine consists of five sections, denoted by A, B, C, D and E. A denotes the forming section; B denotes the pressing section; C denotes the drying section; D denotes the calendaring section; and E denotes the coating section. As shown on FIG. 1, monitoring means 10 are strategically positioned at various locations of interest along the paper making machine.

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Observing means 10 may vary widely and depends on a pre-determined characteristic of the product being monitored for deviation events. Illustrative of useful observing means are those which employ coherent or non-coherent visual, gamma, infra-red, ultraviolet, thermal and nuclear radiation, sonics, ultrasonics, magnetic fields, pressure, odor and the like. The particular observing means 10 used in any particular situation will normally depend on the pre-determined characteristics of the product being observed and the event which indicates a deviation from the pre-determined characteristic. For example, if the pre-determined characteristic is continuity of the web of paper and the deviation is a break or hole in the web, then monitoring means which employs visual radiation such as a video camera can be conveniently employed. On the other hand, if the pre-determined characteristics are moisture content, surface texture, color, gloss and the like monitoring means which involve the use of visual and infrared radiation may be used.

In the preferred embodiment of this invention depicted in FIG. 1, monitoring means is a plurality of video cameras 10. While seven cameras 10 are depicted in the FIGURE, the number of cameras employed may vary widely, and any number capable of providing the desired degree of monitoring can be employed. The positioning of various monitoring means 10 may vary widely depending on the needs of the user. In the preferred embodiment depicted in FIG. 1, where the pre-determined characteristic of the web being monitored is web continuity and deviations in this characteristic being detected are break events, hole events or a combination thereof, the number of cameras 10 and camera positions are such that locations where breaks are most likely to occur are covered. For example, as depicted in FIG. 1, cameras 10 are positioned at the drawing section, coating section, size pressing section, center rolls section, sheet pick-up section and reeling device section.

The system of this invention also includes digital converting means 12 means for converting data obtained or generated by monitoring means 10 into a digital format. Digital converting means employed may vary widely and any such means capable of performing this function may be used. Illustrative of suitable digital converting means 12 are electronic circuit boards, converting signal processors, video boards, micro-chips, and assorted software. The number of digital converting means 12 and the relationship of digital converting means 10 to monitoring means 10 may vary widely, the only requirement is that relevant monitored data is eventually converted into digital format. For example, there may be a single digital converting means 12 for each monitoring means 10 or there may be one or more digital converting means 12 for all monitoring means 10 or various other combinations of converting means 12 and monitoring means 10 may be employed. Digital converting means 12 and monitoring means 10 may be separate devices as depicted in FIG. 2, or these functions may be performed by the same device as for example a digital video camera 10 which directly monitored data in a digital format, which data is conveyed directly to digital data storage means 18 via conductor 11.

As depicted in FIG. 1, each video camera 10 monitors the web and monitored data is generated in an analog format. The analog data is then conveyed to digital converting means 12 via conductor 14 where the analog data is converted to digital format by digital converting means 12, with or without data compression. The digitized data is then conveyed via conductor 16 to digital data storage means 18.

The specific digital data storage 1 means 18 may vary widely provided that such means allows storage of segments

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of digitized data having a pre-determined length which covers data obtained by monitoring means 10 which cover the real time operations of the machine over a predetermined period of time. The segment, in turn, is comprised of a plurality of digitized data clips which are also of a pre-determined length which also cover the real time operations of the machine over a predetermined period of time. The segments and clips are in chronological order and are preferably identified by date and time at which the data was collected which greatly facilitates access to relevant data clips on occurrence of a deviation event. Preferably, the clips are also stored such that clips can be readily identified by time and date, and can be extracted or copied from the segment. A further requirement of the digital memory storage 1 means 18 is that it can be controlled by a control means 20 such that specific clips can be extracted from the digital data storage means 18 as desired and as will be described hereinbelow in more detail. In the operations of the digital data storage means 18, the segment is maintained at or about the pre-determined length during the operations of the system such that as new digitized real time data is added to digital data storage means 18, the oldest or most prior data is erased, deleted or otherwise removed from storage means 18 maintaining said segment at or about some pre-determined length. The advantages of this storage means 10 becomes readily apparent in that stored digital data showing normal operations to produce the product having the pre-determined characteristic is constantly removed from storage means 18 such that upon storage of deviating digitized data of a deviation from the pre-determined characteristic, as for example a break event, such deviating data can be more easily isolated from the relatively small amount of data comprising the segment.

The pre-determined length of the segment and the clips may vary widely initially and during the operation of the system, usually depending upon function and capacity of the digital data storage means, duration of the deviation event and the like. The length of the segments are preferably less than about 60 minutes, more preferably from about 15 to about 60 minutes, and most preferably from about 15 to about 30 minutes. The length of the clips comprising a segment is preferably less than about 60 secs., more preferably from about 5 to about 60 secs., more preferably from about 5 to about 20 to 30 secs and most preferably from about 5 to about 10 secs.

The digitized data storage means 18 utilized in any particular situation may vary widely. Illustrative of useful data storage means 18 are hard drive, tape, diskette, CD rom, magnetic optical drive, solid state memory, flash memory, optical device, and the like. Preferred digitized data storage means 18 are hard drives and CD roms. As depicted in FIG. 1, the most preferred digitized data storage means 18 is a hard drive and is in communication with control means 20 by way of connector 22. Control means 20 functions to control the system. Useful control means 20 may vary widely, the only requirement is that means 20 is in the event of a deviation event able to locate the data clip containing data of such event, to extract such data clip and to display said data clip. Illustrative of useful control means 20 are analog control system and a digital computer.

As depicted in FIG. 1, control means 20 is a digital computer which communicates via connector 24 to a plurality of display means 26 which in the embodiment of FIG. 1 are video monitors. Useful display means 26 may vary widely the only is that such means is capable of displaying data to the satisfaction of the operator. Other useful display means 26 are printers, projection systems, photographic

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imagers and the like. Also connected to control means 20 by way of cable 20 is a 30 as for example a VCR for recording for wider distribution of data and a library 32 for storage of data by way of cable 34. As depicted in the FIGURE, library 32 can be accessed from various locations by remote access means 36 such as a local area network, wide area network, e-mail services, satellite, compact disk and the like connected to library 32 via cable 40.

FIG. 1 also depicts a plurality of deviation detectors 38 strategic positioned along the machine in a well known manner to detect deviations in the pre-determined characteristics in the product being monitored. Detectors 38 are connected to the machine control or distributive control system 40 via cable 42 for transmission of a deviation signal to system 40. System 40 also communicates with control 20 via cable 40 such that various information can be transmitted to control 20 from system 40 in the event of a deviation from the pre-determined characteristic as for example a break in a web. Such information includes the detection of a deviation event, time of detection of the deviation event and such other process data relating to the operations of the machine at the time of deviation event deemed appropriate.

In operation, monitoring means 10 continuously monitors a pre-determined characteristic of the product being produced by the machine. The monitored data is conveyed via cable 16 to digital conversion means 12 where the data is converted to a digital format, and the digitized data is conveyed to digital data storage means 18 via cable 16 for storage. In those embodiments of the invention where the monitored data is collected in digital format by monitoring means 10, as for example by a digital video camera, the digitized data is converted directly to digital data storage means 18 via cable 11. During operations where there are no deviations from the pre-determined characteristics, digitized data flows continuously into storage means 18 such that only a pre-determined amount of data converting a pre-determined period of time during the operation of the machine is always maintained in storage and that as new data is stored the oldest or most prior data is deleted or erased.

If a deviation in the pre-determined characteristics of the product occurs, it is detected by a deviation detector 38. Detector 38 sends a deviation signal to distributive control system 40 via cable 42, and the signal is relayed to control means 20 via cable 48. In addition to a deviation signal, detector 38 may also inform control system 40 of the identity of detector 38 detecting the deviation event, the time of the deviation event and location in the process of the deviation event. This information together with other process data such as type of product being manufactured, machine operation parameters, machine speed, draw ratios, furnish, types, additives, coating components, calendaring pressures, coating thickness, basis weight of the paper and the like are conveyed to control means 20. On receipt of the deviation event signal, control means 20 is capable of identifying the clip most likely to have digitized data relating to the deviation event, and extracting such clip and displaying the extracted clip with display means 26. For example, control means 20 can perform this function by coordinating the time at which deviation event detector 38 detected the deviation event with the clip or clips corresponding in time. This coordination can be done in any suitable manner. For example, control 20 can scan all digitized data storage means 18, select clips from all means 18 containing data collected at the appropriate time and can then scan each clip to identify the deviation event and display same. Alternatively, control means 20 can identify the monitoring

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means 10 most proximate to the location of the deviation event, select a clip or clips from the digitized data storage means 18 for such monitoring means 10 and display such clip. In order to insure that all suitable data is displayed in the fastest possible time, preferably control means 20 will also extract digitized data clips immediately preceding and following the clip or clips most likely containing data for the deviation event and will splice the deviation event clip and the following and preceding clips into a display clip for display. By splicing the event, preceding and following clips, the operation of the machine prior to, during and subsequent to the deviation event can be observed. After a deviation is detected, the machine is usually stopped and the digitized data storage means 18 is frozen to prevent loss of critical data.

The clips can be displayed automatically or manually at any suitable speed. The clips can be displayed frame by frame, in various sizes. The clips can also be viewed in reversed mode. This function combined with a pause, playback and resizing can enhance the ability of the operators to locate the exact point of interest on the display clip, for study showing the deviation event as it occurred. Of course, many other functions may be provided by control means 20 including zooming, edge enhancement, image sharpening, gradient edge enhancement, de-specking, filtering, cropping, desizing, dithering, interpolation, image intensity, format conversion, color inversion, contrast control, brightness control, embossing and the like. Manual/automatic control of all functions may be provided.

In this manner, the control means 20 becomes the driver which also manages the logistics of the system including monitoring, displaying, storage, etc., and can additionally be used to supervise the status of each device in the system as desired. In addition, other peripherals can be provided as needed.

The ability to review the critical period just prior to the deviation event at any desired speed provides the input necessary to evaluate the cause of the problem so that necessary adjustments and/or repairs can be started quickly and the machine restored to normal operation. If only a defect in the product is to blame, this, too, often will show up. In this manner, valuable time can be saved.

The clip or clips covering the deviation event are displayed, the cause of the deviation event can be discovered and appropriate action can be taken to correct the cause of the event. The process or machine and the monitoring system can then be reactivated.

The clips relating to the deviation event together with any other process data associated with the deviation event are conveyed via line 34 to library 32 for storage. In this manner, a collection of deviation clips and associated process data is formed which can be accessed by remote access 36 via connector for suitable purposes as for example for accessing, and correlating or otherwise evaluating accessed data based on or more variables such as process times, properties, products, types or modes of deviation events, recorded observations, types of machines, and like process or product characteristics, and to document machine or process defects such as a hole in the felt or wire. The clips and associated process data may also be conveyed via connector 38 to video recorder 30 for storage on a video tape.

This invention has been described in this application in considerable detail in order to comply with the Patent Statutes and to provide those skilled in the art with the information needed to apply the novel principles and to construct and use such specialized components as are

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required. However, it is to be further understood that the invention can be carried out by specifically different equipment and devices and that various modifications both as to equipment and procedure details can be accomplished without departing from the scope of the invention.

What is claimed is:

1. A monitoring system for continuously monitoring a process comprising:

a plurality of monitoring means for continuously monitoring a pre-determined characteristic of the process and collecting monitored data, each monitoring means addressing a different location of interest of said process, and capable of monitoring and collecting real time data relative to said location;

data converting means for converting said output data into digitized data;

digital data storage means capable of storing segments of said digitized data, each of said segments comprised of a plurality of digitized data clips, said segments and said clips of predetermined lengths which cover the operations of said process at a relevant location over a predetermined period of time, said digitized data segments being stored such that as new digitized data is stored in said segment, the earliest prior stored digitized data in said segment is displaced from said segment to maintain said segment at said predetermined length; and

control means for controlling said monitoring system, said control means in communication with said digital data storage means and capable of extracting one or more digitized data clips according to predetermined criterion to form one or more extracted clips, and capable of displaying said extracted clips.

2. System of claim 1 wherein said pre-determined criterion is a deviation event in which there is a deviation in said pre-determined characteristic.

3. System of claim 2 wherein said process is a continuous process for the manufacture of a product, and said deviation event is a deviation in a pre-determined characteristic of said product.

4. System of claim 3 which comprises a plurality of storage means, each of which comprises at least one digitized data segment, at least one of said storage means capable of storing digitized data monitored and collected from first monitoring means at a first location of the process and at least one of said storage means capable of storing data monitored and collected from a second monitoring means at a second location of the process.

5. System of claim 4 wherein each of said plurality of storage means is capable of storing digitized data monitored and collected by a single monitoring means.

6. System of claim 5 wherein said control means is capable of extracting clips from segments stored in two or more of said plurality of said storage means such that said extracted clips are time synchronized to chronologically show the pre-determined characteristic of a single discrete product or a portion of a continuous product as said product passes by each location of the digitized data in said extracted clips, splicing said extracted clips in chronological order to form a display clip and displaying said display clip.

7. System of claim 3 wherein said process comprises a plurality of steps and wherein there is at least one monitoring means for each of said steps.

8. System of claim 7 wherein said control means is capable of extracting the event clip recording said event and the clip immediately preceding said event clip, splicing said clips in chronological order to form a display clip and displaying said display clip.

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9. System of claim 8 wherein said control means is capable of extracting the event clip recording said event, the clip immediately preceding said event clip, the clip immediately following said event clip, splicing said clips in chronological order to form a display clip and displaying said display clip.

10. System of claim 3 wherein said process is controlled by a distributive control system in communication with said control means, said control system having one or more deviation detectors for monitoring said pre-determined characteristic, each of said detectors addressing a different location of interest along the process and capable of detecting deviation events and communicating a signal of said deviation event, and the time and location of said event to said control means;

wherein on receipt of said deviation event signal said control means capable of identifying data storage means containing the digitized data segment corresponding to said deviation event, extracting the deviation event clip to form a display clip and displaying said display clip.

11. System of claim 10 wherein said distributive control system is further capable of communicating process data relating to the operation of the process and the time of break to said control means.

12. System of claim 11 which further comprises:

library means in communication with said control means for storage of display clips and process data relating to the operation of the machine at the time of break, said library capable of providing for display of said stored display clips and process data.

13. System of claim 1 wherein a plurality of monitoring means address a single location, each in communication with a digital data converting means which is in communication with a digital data storage means, said control means capable of extracting one or more digitized data clips from each of said storage means and capable of displaying said extracted clips.

14. A system of claim 13 wherein each of said monitoring means monitors a different pre-determined characteristic.

15. A system of claim 14 wherein said monitoring means are different.

16. A monitoring system for monitoring the manufacture of a continuous web of paper having one or more pre-determined characteristics in a paper manufacturing machine comprising:

a plurality of monitoring means which comprises one or more video cameras for monitoring the paper web, each monitoring means addressing the paper web at a different location of interest along the paper manufacturing machine and capable of producing a video image of the paper web at the location;

digital converting means for converting the video image into a digitized video signal;

digital data storage means capable of receiving said digitized video signal and storing digitized segments thereof, each of which comprises a plurality of digitized clips, said digitized segments and clips of a predetermined length covering real time operation of said machine, said digitized segments being stored such that the earliest prior stored digitized data in said segment is displaced as new digitized data, is stored in said segment to maintain said stored segment at said predetermined length;

Computer control means for controlling the operations of said system, said means in communication with said

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digital data storage means and capable of controlling same, said computer control means in communication with a distributive control system for controlling said machine, said system having one or more deviation detectors for detecting deviations from predetermined characteristics as said paper web passes through said machine said control system capable of communication process master time and date information to said computer control system; and

one or more video monitors in communication with said computer control means and capable of displaying the image of digitized video signals under the control of said computer control means;

wherein on occurrence of a deviation from the predetermined characteristics of said web, said distributive control system transmits a deviation signal comprising the time, date and location of said deviation event to said computer control means, and in response thereto said computer control means identifying the digitized data segment corresponding to said deviation event, extracting the deviation event clip, the preceding clip preceding said break event clip to form a display clip and displaying said display clip on a video monitor.

17. System of claim 16 wherein at least one digital converting means is in communication with at least one video camera and at least on digital data storage means is in communication with at least one digital converting means.

18. System of claim 17 wherein on receipt of said deviation event signal at the time of said deviation, said computer control means identifies a video camera proximate to said deviation detector detecting said deviation event, freezes operations of digital memory storage means for such camera, identifies the digitized data segment corresponding to said deviation event by correlating the time of said segment with the time of said deviation event, extracting the deviation event clip which correlates to the time of said deviation event and the preceding clip preceding said deviation event clip and the subsequent clip following said deviation event clip, splicing said deviation event clip, said preceding clip and said subsequent in chronological order to form a display clip and displaying said display clip on said video monitor.

19. System of claim 18 which further comprises:

means for transmitting process data from the distributive control system with said break event signal;

library means for storage of display clips and associated process data; and

means for accessing said display clips and process data stored in said library.

20. System of claim 16 wherein said event is selected from the group consisting of a break in said web, a hole in said web and a change in a surface characteristic of said web.

21. A monitoring system for continuously monitoring a process comprising:

a plurality of monitoring means for continuously monitoring a pre-determined characteristic of the process and collecting monitored data, each monitoring means addressing a different location of interest of said process, and capable of monitoring and collecting real time date relative to said location;

data converting means for converting said collected data into digitized data;

digital data storage means for storing segments of said digitized data, and each of said segments comprised of one or more digitized data clips, said segments and said clips of predetermined lengths which cover the opera-

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tions of said process over a predetermined period of time, said digitized data segments being stored such that as new digitized data is stored in said segment, earlier prior stored digitized data in said segment is removed from said segment to maintain said segment at or about said pre-determined length; and

at least one computer in communication with said digital data storage means, and configured to extract a deviation digitized data from one or more of said segments of digitized data after receipt of a signal of a deviation from said predetermined characteristics, and further configured to display said extracted deviation digitized data.

22. System of claim 21 wherein said digital data storage means in selected from the group consisting of a computer hardware, tape, diskette, CD ROM, magnetic optical drive, solid state memory, flash memory and optical drive.

23. System of claim 21 wherein said monitoring means is one or more video cameras.

24. System of claim 23 wherein said process is for the manufacture of a product.

25. System of claim 24 wherein said product comprises a continuous web of paper.

26. System of claim 25 wherein said process is for printing said web of paper.

27. System of claim 25 wherein said process is for manufacturing said web of paper.

28. System of claim 25 wherein said predetermined characteristic is a characteristic of said web.

29. System of claim 28 wherein said predetermined characteristic is continuity of said web.

30. System of claim 29 wherein said deviation is a break or hole in said web.

31. System of claim 28 wherein said system further comprises one or more deviation detectors for monitoring said predetermined characteristics and for detecting deviations therefrom.

32. System of claims 28 where in said monitoring means and said deviation detectors are combined in said video camera.

33. System of claim 28 wherein each of said monitoring means and said data converting means are combined in a digital camera.

34. System of claim 28 wherein said deviation signal comprises the time, location or time and location of said detected deviation.

35. System of claim 21 wherein said system further comprises one or more deviation detectors for monitoring said predetermined characteristics and for detecting deviations therefrom.

36. System of claim 35 wherein said monitoring means and said one or more detectors are combined in said video cameras.

37. System of claim 21 wherein said deviation signal comprises the time, location or time and location of said detected deviation.

38. A monitoring system for continuously monitoring a process for the manufacture of a product comprising a continuous web of paper, said system comprising:

a plurality of monitoring mean comprising a plurality of video cameras for monitoring a predetermined characteristic of the process and collecting monitored data, said cameras addressing locations of interest of said process and said cameras for producing video images relative to said locations;

digital data converting means for converting said video images into digitized video signals;

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digital data storage means for receiving said digitized video signals and for storing segments of said digitized video signals, said segments which cover the operations of said process over a predetermined period of time, said digitized video signals being stored such that as new digitized video signals are stored in a segment, earlier prior stored digitized video signals in said segment are removed from said segment to maintain said segment at or about a predetermined length; and at least one computer in communication with the digital data storage means, and configured to receive a deviation signal in the event of a deviation from said predetermined characteristics and to extract a deviation digitized video signal from at least one of the segments of digitized video signals after the deviation signal is received, and further configured to display the extracted deviation digitized video signal.

39. System of claim 38 wherein said system further comprises a plurality of deviation detectors configured to detect a deviation from the predetermined characteristic and to transmit a deviation signal indicating the detected deviation to said at least one computer.

40. System of claim 38 wherein said system further comprises one or more video monitors for displaying an image defined by the extracted deviation digitized video signal and wherein at least one computer is further configured to control the display of the image on at least one of said one or more video monitors.

41. System of claim 38 wherein said deviation is a break or hole in said web.

42. System of claims 38 where in said deviation signal comprises the time, location or time and location of said detected deviation.

43. A monitoring system for continuously monitoring a process for the manufacture of a product comprising a continuous web of paper, said system comprising:

a plurality of video cameras positioned at locations of interest in the process and configured to produce video

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images of the locations of interest so to monitor a predetermined characteristic of the process;

at least one digital data converter in communication with the plurality of video cameras and configured to convert the video images into digitized video signals;

at least one digital data storage device in communication with the at least one digital data converter and configured to receive and store the digitized video signals as segments so that as new digitized video signals are added, earlier prior stored digitized video signals are removed in order to maintain the segments at or about a predetermined length; and

at least one computer in communication with the at least one digital data storage device and the plurality of deviation detectors, and configured to extract a deviation digitized video signal from at least one of the segments of digitized video signals after the deviation signal is received, and further configured to transmit the extracted deviation digitized video signal for display.

44. System of claim 43 wherein said system further comprises a plurality of deviation detectors configured to detect a deviation from the predetermined characteristic and to transmit a deviation signal indicating the detected deviation to said at least one computer.

45. System of claim 43 wherein said system further comprises one or more video monitors for displaying an image defined by the extracted deviation digitized video signal and wherein at least one computer is further configured to control the display of the image on at least one of said one or more video monitors.

46. System of claim 43 wherein said deviation is a break or hole in said web.

47. System of claim 43 wherein said deviation signal comprises the time, location or time and location of said detected deviation.

* * * * *

EXHIBIT 7

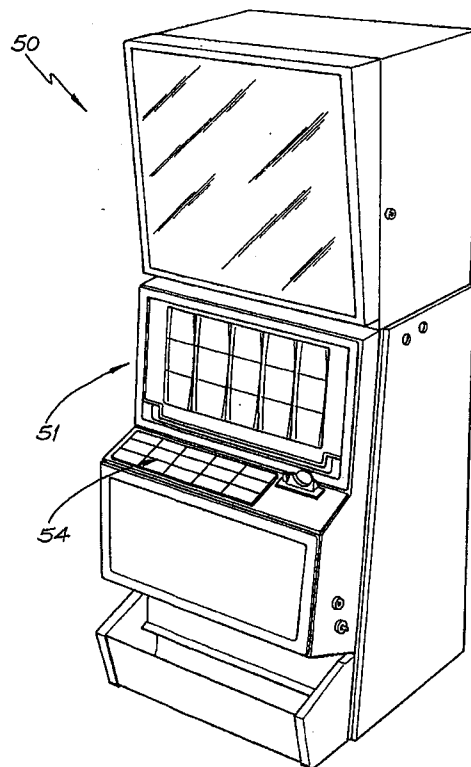
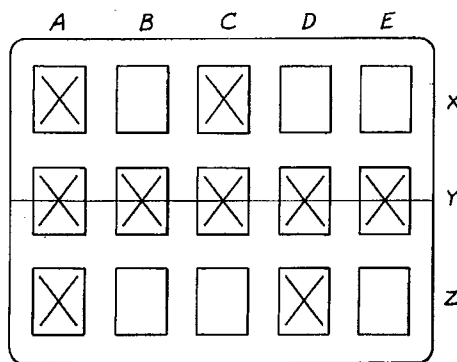
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United States Patent [19]**Bennett**[11] **Patent Number:** **6,093,102**[45] **Date of Patent:** **Jul. 25, 2000**[54] **MULTILINE GAMING MACHINE**[75] **Inventor:** **Nicholas Luke Bennett, Manly Vale, Australia**[73] **Assignee:** **Aristocrat Leisure Industries Pty Ltd, Lane Cove Zoff, Australia**[21] **Appl. No.:** **08/809,658**[22] **PCT Filed:** **Sep. 12, 1995**[86] **PCT No.:** **PCT/AU95/00598**§ 371 Date: **Mar. 15, 1997**§ 102(e) Date: **Mar. 15, 1997**[87] **PCT Pub. No.:** **WO96/08799****PCT Pub. Date: Mar. 21, 1996**[30] **Foreign Application Priority Data**Sep. 15, 1994 [AU] **Australia** PM8161[51] **Int. Cl.⁷** **G07F 17/34**[52] **U.S. Cl.** **463/20; 463/16; 273/138.1**[58] **Field of Search** **463/16, 20, 21; 273/138.1, 142 R, 142 B, 143**[56] **References Cited****U.S. PATENT DOCUMENTS**Re. 34,244 5/1993 Hagiwara 463/20
5,580,053 12/1996 Crouch 463/20**FOREIGN PATENT DOCUMENTS**82126 6/1975 **Australia** .
2119989 5/1982 **United Kingdom** .
2137392 2/1983 **United Kingdom** .
2150844 12/1984 **United Kingdom** .
2187320 2/1987 **United Kingdom** .
2258334 7/1992 **United Kingdom** .**Primary Examiner**—Jessica J. Harrison**Assistant Examiner**—John M. Hotaling, II**Attorney, Agent, or Firm**—Rosenman & Colin LLP

[57]

ABSTRACT

A gaming machine has a display which displays a symbols in an array format of n rows and m columns of symbol positions. A game control controls images displayed on the display and is arranged to pay a prize when a predetermined combination of symbols is displayed in a predetermined arrangement of symbol positions including one and only one symbol position in each column of the array. The number of said predetermined arrangements in the gaming machine for any one game is a value which is the product $k_1 \times \dots \times k_i \times \dots \times k_m$, where k_i represents a number of symbol positions which have been selected by the player in an i^{th} column of the n rows by m columns of symbol positions on the display ($0 < i \leq m$ and $k_i \leq n$). At least one symbol position is selected from each column, and the number of predetermined arrangements represents the number of possible combinations of the selected symbol positions which have one symbol position in each column of the display means.

12 Claims, 4 Drawing Sheets

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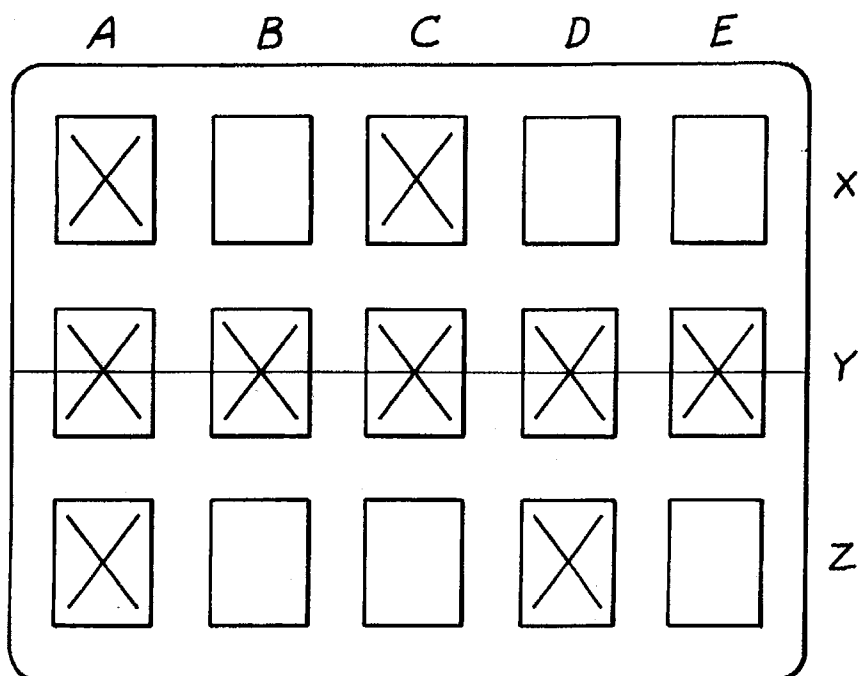


FIG. 1

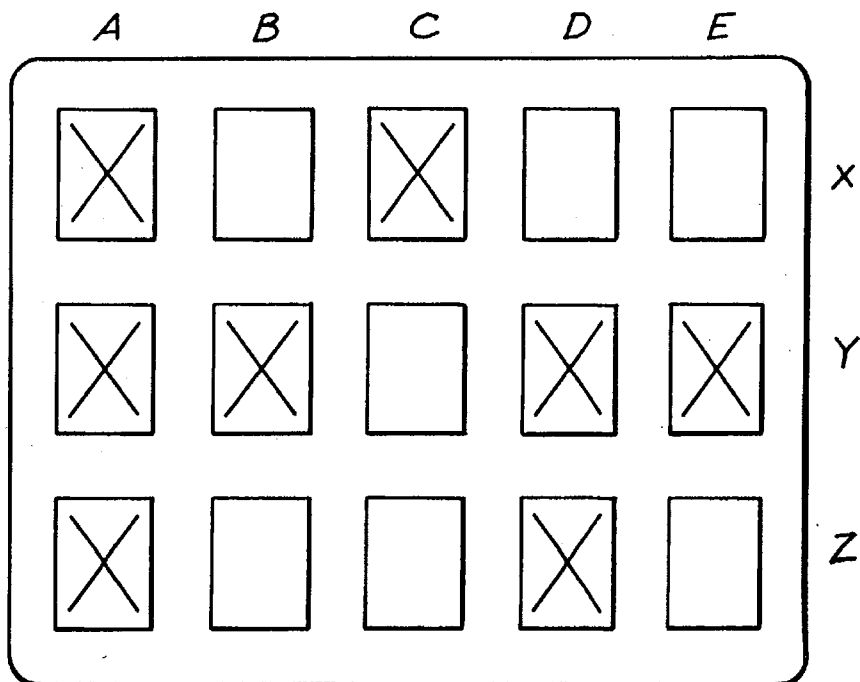


FIG. 2

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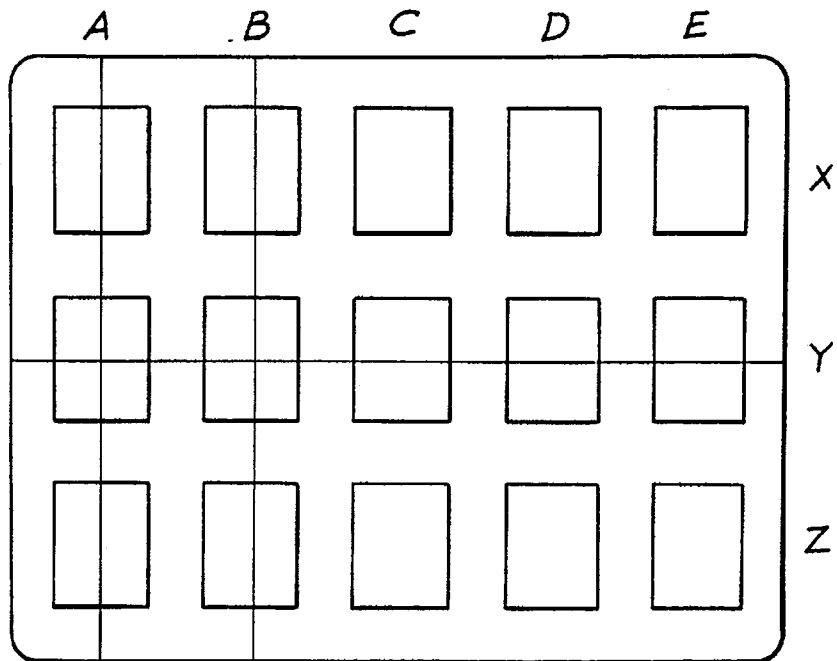


FIG. 3

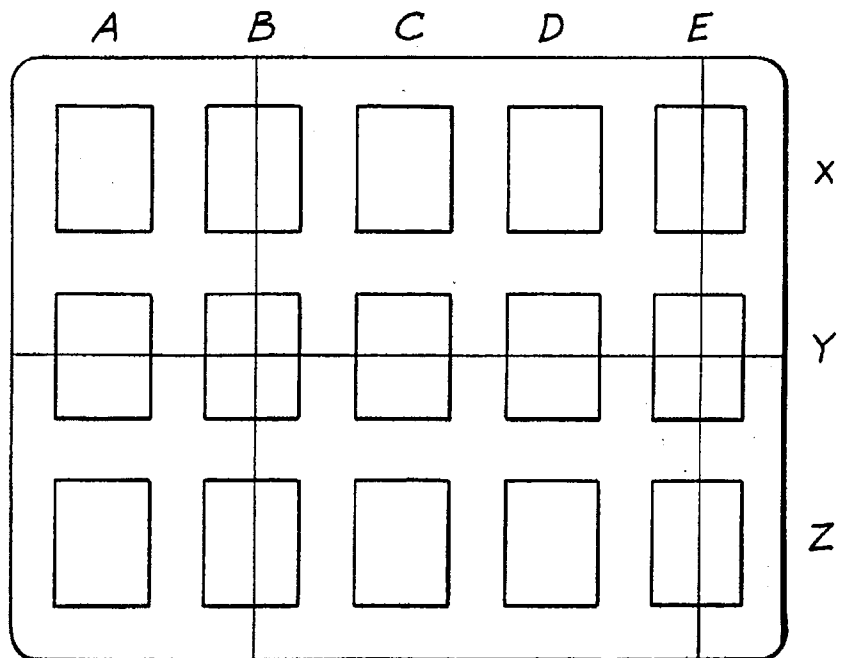


FIG. 4

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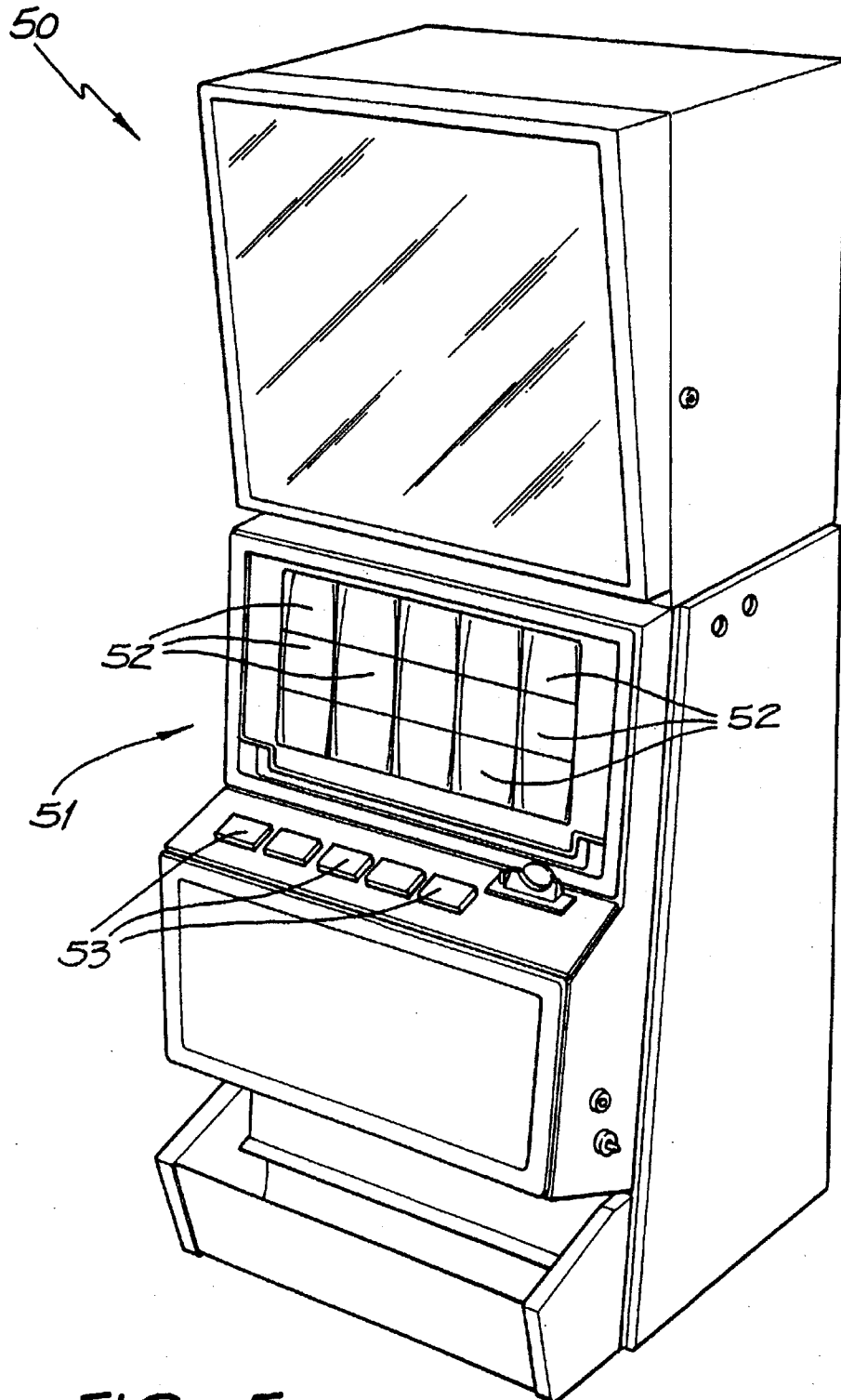


FIG. 5

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MULTILINE GAMING MACHINE**IMPROVED MULTILINE GAMING MACHINE**

The present invention relates to gaming machines of the type generally referred to as slot machines, fruit machines or poker machines, and in particular the invention provides an improvement to a game played on such a machine.

Players who regularly play gaming machines quickly tire of particular games and therefore it is necessary for manufacturers of these machines to come up with innovative game features that add interest to the games provided on such machines in order to keep the players amused and therefore willing to continue playing the game.

DESCRIPTION OF THE PRIOR ART

Gaming or poker machines have been well known in the state of New South Wales for many years and have more recently gained considerable popularity throughout Australia, with quite substantial amounts of money wagered on these machines. There is a growing tendency for State governments to legalise the use of gaming machines by licensing operators, with resulting revenue gains through licence fees and taxation of monies invested. The licensed operation of gaming machines is the subject of State legislation and regulation. This regulation most always dictates a minimum percentage payout for a gaming machine. For example, a minimum of 85% of monies invested must be returned as winnings, and manufacturers of gaming machines therefore must design their machines around these regulatory controls.

With the growth that has occurred in the gaming machine market there is intense competition between manufacturers to supply the various existing and new venues. When selecting a supplier of gaming machines, the operator of a venue will often pay close attention to the popularity of various games with their patrons.

Therefore, gaming machine manufacturers are keen to devise games which are popular with players, as a mechanism for improving sales.

Many various strategies have been tried in the past to make games more enticing to players, and these strategies are often aimed at either increasing the maximum prize payable on a machine or creating at least the perception of more winning opportunities. The present invention falls into the latter category. For quite a few years, it has been possible to bet on more than one pay line of a slot machine simultaneously. However this feature has been restricted by the number of pay lines that could be achieved on the display format commonly used in slot machines.

Originally, the term "pay line" included within its scope only straight line arrangements of symbol locations (e.g. horizontal lines, and diagonals in 3x3 machines). In fact original slot machines only paid on the horizontal centreline of symbol locations.

In the more recent past "pay lanes" have been devised which are not straight line arrangements of symbol locations although these more recent payline arrangements have still included only symbol locations that were horizontally or diagonally adjacent to one another and always included only one location in each column of the display.

In embodiments of the present invention, paying symbol arrangements are proposed in which symbol locations in adjacent columns of the display are not necessarily horizontally or diagonally adjacent to one another. Throughout this specification these new paying symbol arrangements are still

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referred to as "pay lines" although in the conventional sense they are not strictly lines at all.

The present invention provides an arrangement whereby the number of pay lines provided on a slot machine, particularly a machine with 3x5 display, can be increased without changing the display format.

SUMMARY OF THE INVENTION

The present invention consists in a gaming machine having display means arranged to display a plurality of symbols in an array of n rows and m columns of symbol positions, game control means arranged to control images displayed on the display means the game control means being arranged to pay a prize when a predetermined combination of symbols is displayed. In a predetermined arrangement of symbol positions including one and only one symbol position in each column of the array, the gaming machine being characterised in that the number of said predetermined arrangements for any one game is a value which is the product $k_1 \dots k_i \dots k_m$ where k_i represents a number of symbol positions which have been selected by the player in an i^{th} column of the display ($0 < i \leq m$), at least one symbol position being selected from each column, and the number of predetermined arrangements being the number of possible combinations of the selected symbol positions which have one symbol position in each column of the display means.

The preferred embodiments of the invention use a display means which displays symbols in 3 rows and 3, 4 or 5 columns.

In a particular embodiment the number of predetermined symbol arrangements for any one game is a value n^j where j is less than or equal to m , is directly or indirectly player selectable and represents a selected number of columns of the display means whereby each predetermined arrangement is made up of m symbol positions one selected from each of the m columns, the predetermined arrangement used for a given value of j being all possible combinations using one symbol position from each of j selected columns of the display means combined with the symbol positions in a predetermined row from the remaining $m-j$ columns.

In this embodiment, rather than individually selecting symbol positions, a player will select columns of symbol positions as a group. This arrangement has the advantage that the selection mechanism is simplified.

Preferably the display format will have three rows and the predetermined row from which the remaining $m-j$ symbol positions are selected is a centre row.

Preferably also the j columns will be a left most j columns of the display means.

The invention is equally applicable to video machines and machines employing spinning reels.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings in which:

FIGS. 1, 2, 3 and 4 diagrammatically illustrates four possible embodiments of a 243 line multi-line pay arrangement for a machine with a 3x5 display format; and

FIGS. 5 and 6 illustrate two possible machine configurations in which the games described with reference to FIGS. 1 to 4 may be employed.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following detailed description, the methodology of the embodiments will be described and it is to be understood

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that it is within the capabilities of the non-inventive worker in the art to introduce the methodology on any standard microprocessor base gaming machine by means of appropriate programming.

Traditional slot machines have made use of spinning reels to provide a display function with symbols carried on the reels being aligned to produce a game result which may or may not be a winning combination. Traditionally such machines paid a prize only on a centre row combination, however over the years more complex pay arrangements have been developed in which winning combinations could appear on horizontal lines above and follow the centre row line, and later on diagonal lines (typically on 3 reel machines).

In more recent times video displays have been used to simulate spinning reels on these types of machines and in some instances machines have been provided with matrices of pseudo spinning wheels such as a 3x3 matrix of reels, whereby every single position on the display screen is essentially independently randomly achieved and therefore it was valid to pay on vertical combinations as well as horizontal combinations. In such a machine with a 3x3 symbol matrix display, winning combinations could be achieved on any one of three horizontal pay lines, three vertical paylines and two diagonals, making 8 possible lines on which a result could be assessed.

It is normal for machines of the type having multiple pay lines available, that the player would purchase the option of playing for a win on lines other than the centre line. That is to say, if the player wagered only one token he played only for a winning combination on one line, whereas if he wagered a number of tokens he may well select to wager some of those tokens on lines other than the centre line of the display.

This mechanism adds interest to the game being played by the player as essentially it enables him to make multiple bets simultaneously.

Referring to FIG. 1, a matrix symbolic of a typical three line by five column display matrix is illustrated, and it will be immediately apparent that in such an arrangement diagonal pay lines as conventionally used in 3x3 symbol matrix machines are not appropriate to the 3x5 format. Similarly, in slot machines which play games which follow the traditional format of a plurality of vertical spinning reels, vertical pay lines are not appropriate as there is no significant degree of randomness in the combinations provided on the vertical line.

Therefore, with this in mind the first embodiment of the present invention provides an arrangement for a slot machine having a 3x5 symbol matrix display with 243 possible pay lines being all possible combinations of symbol positions which include one position in each column of the display.

Referring to FIG. 1 a 3x5 display matrix is illustrated and in this embodiment a player may select the symbol positions to be included in their pay line combinations. If the symbol positions marked with an 'x' in FIG. 1 are selected by the player (ie AX, AY, AZ, BY, CX, CY, DY, DZ, EY) then the corresponding pay lines will be as shown in Table 1.

TABLE 1

LINE NO	DISPLAY POSITIONS USED				
1	AX	BY	CX	DY	EY
2	AX	BY	CX	DZ	EY
3	AX	BY	CY	DY	EY
4	AX	BY	CY	DZ	EY

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TABLE 1-continued

LINE NO	DISPLAY POSITIONS USED				
5	AY	BY	CX	DY	EY
6	AY	BY	CX	DZ	EY
7	AY	BY	CY	DY	EY
8	AY	BY	CY	DZ	EY
9	AZ	BY	CX	DY	EY
10	AZ	BY	CX	DZ	EY
11	AZ	BY	CY	DY	EY
12	AZ	BY	CY	DZ	EY

It will be seen that the number of lines produced is given by the product

$$k_1 \times k_2 \times k_3 \times k_4 \times k_5$$

where k_i is the number of symbol positions selected in the i^{th} column of the machine. For an m column display the number of lines would be represented by the product

$$k_1 \times k_2 \times \dots \times k_p \times \dots \times k_m$$

In the embodiment of FIG. 1 the centre line symbol positions are always selected, however it is also possible to produce embodiments in which any single symbol position might be selected in each column and such an embodiment is illustrated in FIG. 2. In this embodiment lines 1,2,5,6,9 and 10 defined in Table 1 will be effective for the symbol positions selected (as marked with a 'x'). In the embodiment of FIG. 2 the selection would default to the centre line position in the event that no symbol was selected in a particular column.

Selection of symbol positions for inclusion on pay lines may be achieved using a number of methods such as placing a touch sensitive layer over each symbol position in the display, or providing a matrix of buttons corresponding to the display matrix format.

FIGS. 3 and 4 illustrate a simplified version of the invention in which players may select columns of symbol positions to be included in their pay line combinations. These embodiments are simpler than those previously described because only one selection mechanism is required per display column. Selection might be by way of touch sensitive membrane over the display or by way of a switch under each column.

In the embodiment of FIG. 3 columns must be selected from the left such that if 3 lines are required column A is selected, if 9 lines are required column B is selected (and column A will be automatically selected), and similarly for 27 lines (column C), 81 lines (column D) and 243 lines (column E). The lines provided when 9 lines are selected are defined in Table 2.

TABLE 2

LINE NO	DISPLAY POSITIONS USED				
1	AX	BX	CY	DY	EY
2	AX	BY	CY	DY	EY
3	AX	BZ	CY	DY	EY
4	AY	BX	CY	DY	EY
5	AY	BY	CY	DY	EY
6	AY	BZ	CY	DY	EY
7	AZ	BX	CY	DY	EY
8	AZ	BY	CY	DY	EY
9	AZ	BZ	CY	DY	EY

In the embodiment of FIG. 4 there is no restriction on which columns are selected and therefore the player must

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indicate each column to be included. The lines selected in FIG. 4 are defined in Table 3.

TABLE 3

LINE NO	DISPLAY POSITIONS USED				
1	AY	BX	CY	DY	EX
2	AY	BX	CY	DY	EY
3	AY	BX	CY	DY	EZ
4	AY	BY	CY	DY	EX
5	AY	BY	CY	DY	EY
6	AY	BY	CY	DY	EZ
7	AY	BZ	CY	DY	EX
8	AY	BZ	CY	DY	EY
9	AY	BZ	CY	DY	EZ

It will be seen that the number of lines produced in the embodiments of FIGS. 3 and 4 is given by

$$n^j$$

where n is the number of display rows and j is the number of columns selected ($0 \leq j \leq m$)

Referring to FIG. 5, a slot machine 50 is illustrated in which symbol positions are selected for inclusion in pay lines by way of a touch sensitive membrane applied over the display screen 51, the membrane being divided into a number of switch panels 52 each of which corresponds with one display position of the display 51. This arrangement can be used to implement the embodiments described with reference to FIGS. 1 and 2.

Each vertical set of touch sensitive panels 52 can be operated in parallel in the embodiments of FIGS. 3 and 4, such that columns of display positions can be selected by touching any switch over the respective column. Alternatively, each set of three vertically aligned switches may be implemented as a single touch panel running over the entire column of display positions.

When implementing the embodiments described with reference to FIGS. 3 and 4, it is also possible to dispense with the touch switches and use the switches 53 located below the display area.

The machine of FIG. 5 is illustrated with a video display but may also make use of a display comprising a plurality of stepping motor driven reels carrying a plurality of symbols.

Turning now to FIG. 6, a further slot machine configuration is shown in which the slot machine 50 is provided with a display 51, which may be either a video display or a stepper motor driven reel display and a matrix of switches 54 corresponding to the format of the display matrix, such that symbol positions can be selected by use of the matrix 54 to define the pay lines applicable for a game played on the machine. This arrangement can be used for the embodiments described with reference to FIGS. 1 and 2.

It will be recognised that other switch configurations may also be employed which multiplex switch functions to reduce the number of switches required.

It will also be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

What is claimed is:

1. A gaming machine having display means arranged to display a plurality of symbols in a display format having an array of n rows and m columns of symbol positions, game control means arranged to control images displayed on the display means, the game control means being arranged to

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pay a prize when a predetermined combination of symbols is displayed in a predetermined arrangement of symbol positions selected by a player, playing a game, including one and only one symbol position in each column of the array, the gaming machine being characterised in that selection means are provided to enable the player to control a definition of one or more predetermined arrangements by selecting one or more of the symbol positions and the control means defining a set of predetermined arrangements for a current game comprising each possible combination of the symbol positions selected by the player which have one and only one symbol position in each column of the display means, wherein the number of said predetermined arrangements for any one game is a value which is the product $k_1 \times \dots \times k_i \times \dots \times k_m$ where k_i is a number of symbol positions which have been selected by the player in an i^{th} column of the n rows by m columns of symbol positions on the display ($0 < i \leq m$ and $k_i \leq n$).

2. The gaming machine as claimed in claim 1 wherein the selection means provides means for selection of each column of symbols as a group and the number of predetermined arrangements for any one game is a value n^j where j is less than or equal to the number of m columns of symbol position and is a number of columns selected for that game, the selected columns being directly or indirectly selectable by the player whereby each predetermined arrangement is made up of one symbol position selected from each of the m columns to give a total number of selected symbol positions p in each predetermined arrangement, where $p=m$, the predetermined arrangements used for a given value of j being all possible combinations using one symbol position from each of the j selected columns of the display means combined with the symbol positions in a predetermined row from the remaining $m-j$ columns.

3. The gaming machine of claim 2, wherein the display format has three rows and the predetermined row from which the symbol positions are selected in the remaining $m-j$ columns of symbol positions is a center row.

4. The gaming machine of claim 2 wherein the j columns are the left most j columns of the display means.

5. The gaming machine of claim 3 wherein the display means is arranged to display symbols in 3 rows and 3 columns.

6. The gaming machine of claim 3 wherein the display means is arranged to display symbols in 3 rows and 4 columns.

7. The gaming machine of claim 3 wherein the display means is arranged to display symbols in 3 rows and 5 columns.

8. The gaming machine as claimed in claim 1 wherein the player is able to select any number of symbol positions in any column of the display with a predetermined position being selected by the machine in any column in which the player does not make a selection, and where the predetermined arrangements used in a given game are all possible combinations of the selected symbol position having one and only one position in each column of the display.

9. The gaming machine of claim 8 wherein the predetermined positions selected by the machine are in the centre row of the display.

10. The gaming machine of claim 9 wherein the display means is arranged to display symbols in 3 rows and 3 columns.

11. The gaming machine of claim 9 wherein the display means is arranged to display symbols in 3 rows and 4 columns.

12. The gaming machine of claim 9 wherein the display means is arranged to display symbols in 3 rows and 5 columns.

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